Micro Series

VITAL SCIENTIFIC N.V.

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All product names that are mentioned in this manual are registered trademarks. The manual describes the Micro Series analyser system and its software version 1.0 (August 2001).

The Micro Series is conceptualised, manufactured and tested in accordance with the declaration of conformity. The declaration is supplied with each device in a separate file.

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10. Mechanical Drawings

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10 Mechanical Drawings

10.1 Spare Parts List

These pages offer you an overview of the ordering numbers annotated to the modular groups as they are required for the Micro Series. Dealers should always consult the latest price list for current ordering information.

Part number	Page
1503-008	10 - 10
1513-001 (36 mm)	10 - 10
1513-052 (52 mm)	10 - 7
1513-052 (75 mm)	10 - 7
1513-052 (68 mm)	10 - 8
1513-024	10 - 8
1573-001	10 - 7
3002-224	10 - 14
3002-307	10 - 9
3004-216	10 - 9
3029-039	10 - 7
3059-017	10 - 14
3066-129	10 - 5
3066-138	10 - 7
3066-138	10 - 8
3066-140	10 - 5
3066-141	10 - 7
3066-146	10 - 8
3066-147	10 - 8
3067-340	10 - 10
3067-405	10 - 10
3067-505	10 - 10
3067-546	10 - 10
3067-578	10 - 10
3067-620	10 - 10
3070-472	10 - 9
3070-473	10 - 9
3070-477	10 - 9

Part number	Page
3070-479	10 - 13
3070-480	10 - 14
3073-025	10 - 12
3073-105	10 - 12
3074-100	10 - 12
3315-276	10 - 5
3342-855	10 - 14
3348-175	10 - 5
3348-123	10 - 4
3350-156	10 - 9
3359-041	10 - 4
3366-922	10 - 7
3367-054	10 - 11
3367-055	10 - 6
3370-526	10 - 5
3370-761	10 - 5
3370-762	10 - 5
3374-101	10 - 4
3374-102	10 - 4
3374-103	10 - 8
3374-104	10 - 11
3374-105	10 - 3
3374-108	10 - 4
3374-112	10 - 8
3374-112	10 - 11
3374-112	10 - 12
3380-018	10 - 9
3380-353	10 - 13

Part number	Page
3380-354	10 - 13
3390-042	10 - 11
3390-131	10 - 6
3750-055	10 - 9
3820-406	10 - 14
4100-347	10 - 7
4100-750	10 - 10
4100-752	10 - 7
4104-118	10 - 10
4509-217	10 - 10
4800-300	10 - 3
4801-142	10 - 11
4802-422	10 - 13
6002-313	10 - 12
6002-320	10 - 10
6002-321	10 - 10
6002-322	10 - 11
6002-326	10 - 7
6002-332	10 - 8
6002-333	10 - 7
6002-333	10 - 8
6002-341	10 - 6
6002-342	10 - 8
6002-344	10 - 4
6002-345	10 - 11
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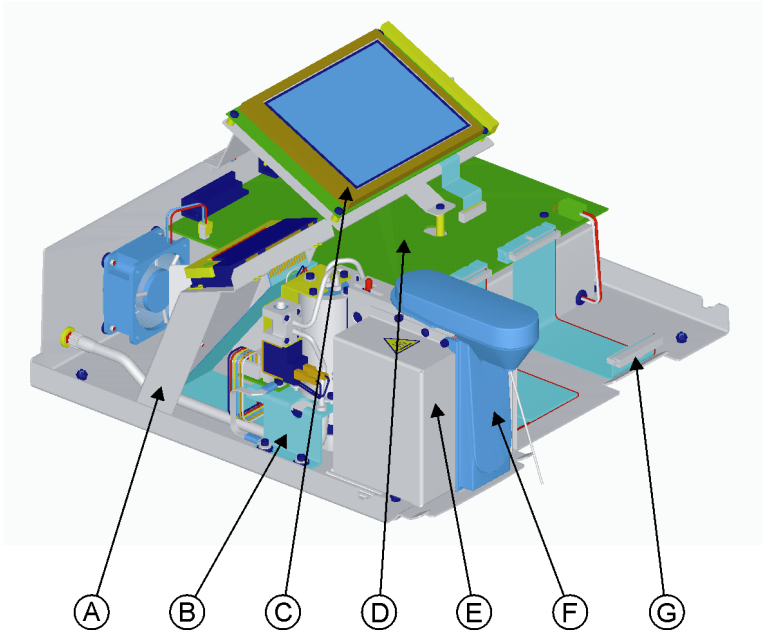
System Overview



	Part number	Item	Amount
A		Printer-assy	1
B		Pump assy	1
C		Display	1
D		Processor board	1
E	4800-300	Lamp cover	1
F		Optical-unit	1
G	3374-105	Cable assy	1

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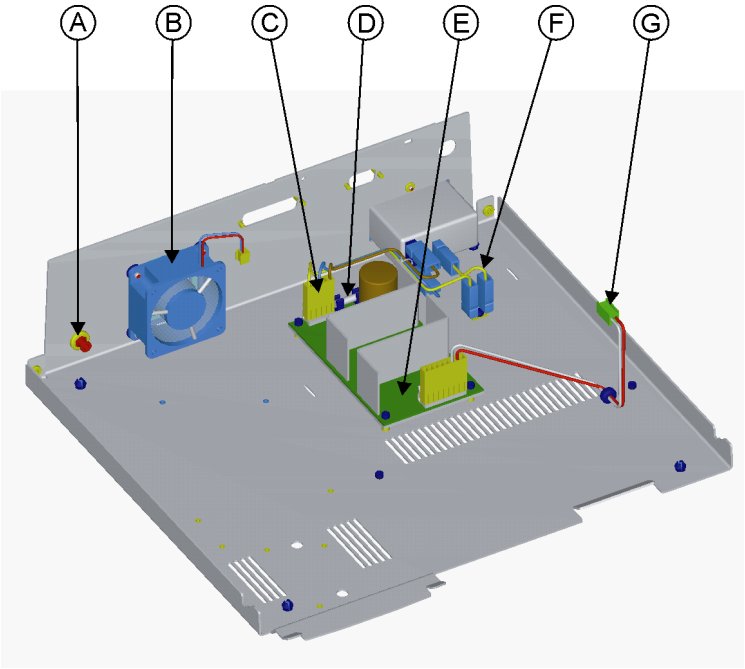
MODULE 1A Baseplate



	Part number	Item	Amount
A	3066-140	Socket	1
B	6002-344	Fan unit inc. connector	1
C	3374-102	Mains cable	1
D	3348-123	Fuse, glass 3 A/250 V fast blow	1
E	3359-041	Power supply	1
F	3374-108	Earth cable	1
G	3374-101	Power dc cable	1

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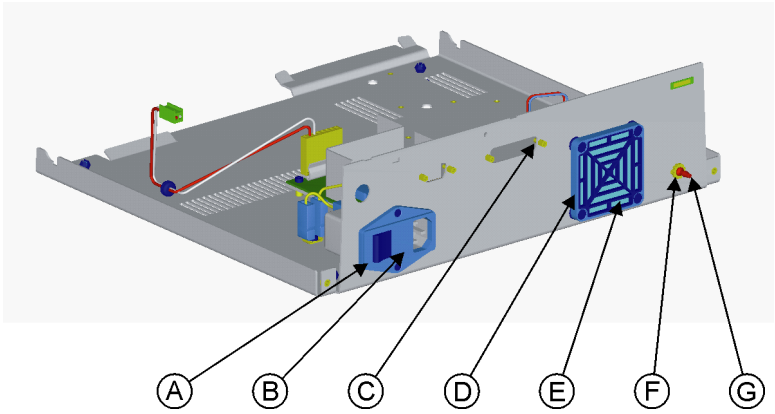
MODULE 1B Baseplate



	Part number	Item	Amount
A	3315-276	Line filter	1
B	3348-175	Fuse, glass 259 V/1.6 A slow blow	2
C	3370-526	Screw locks, female 4-40 unc	4
D	3370-761	Guard, retainer & filter	1
E	3370-762	Filter foam	1
F	3066-129	Nut	1
G	3066-140	Socket	1

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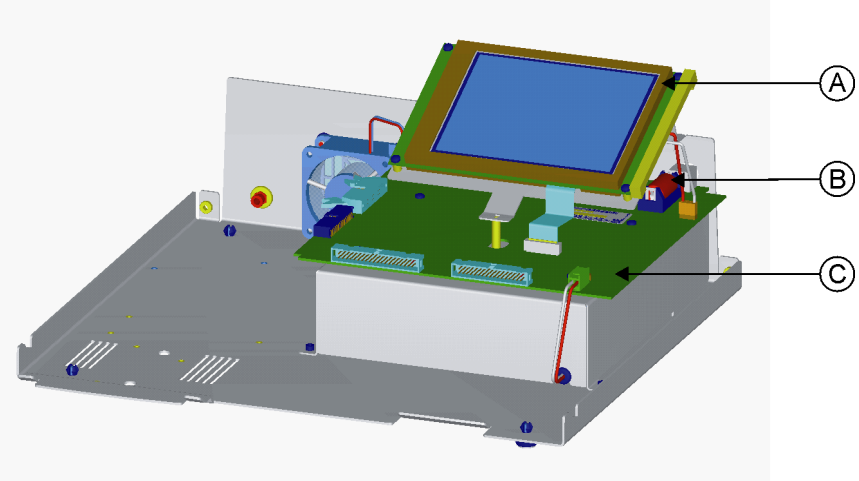
MODULE 2 Display / Processor Board



	Part number	Item	Amount
A	6002-341	Display inc. connectors	1
B	3390-131	Battery 3.6 V	1
C	3367-055	Processor board	1

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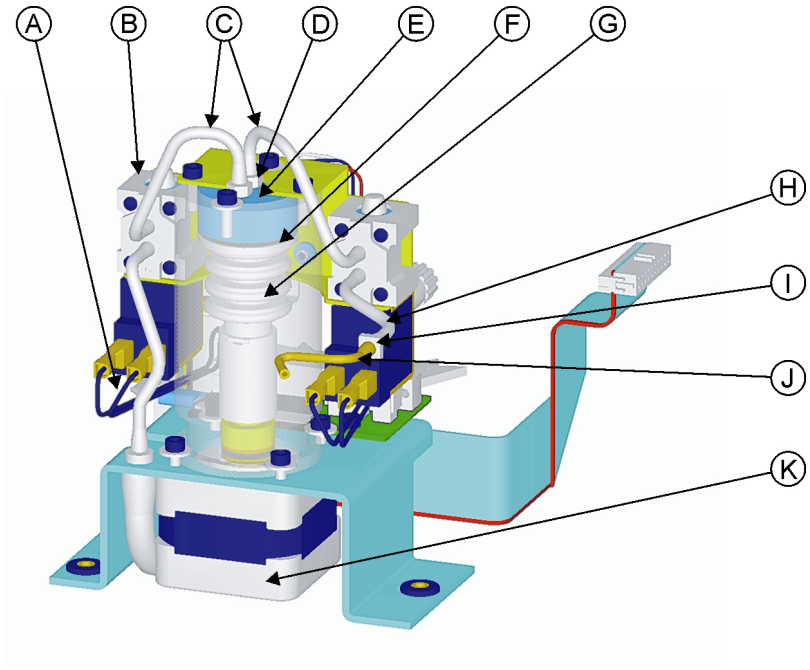
MODULE 3A Pump-unit (housing translucent)



	Part number	Item	Amount
A	6002-333	Valve cable assy	2
B	3366-922	Valve	2
C	1513-052	Tube, PVC 1.5 x 3.5 mm clear (5 m)	2 x 75 mm
D	3066-138	Connector. 10-32 UNF	2
E	4100-752	Cover	1
F	3029-039	O-ring	1
G	4100-347	Bellows	1
H	1513-052	Tube, PVC 1.5 x 3.5 mm clear (5 m)	1 x 52 mm
I	3066-141	Connector	1
J	1573-001	Tube, silicone 0.8 x 2.4 mm (1 m)	1 x 30 mm
K	6002-326	Stepper motor	1

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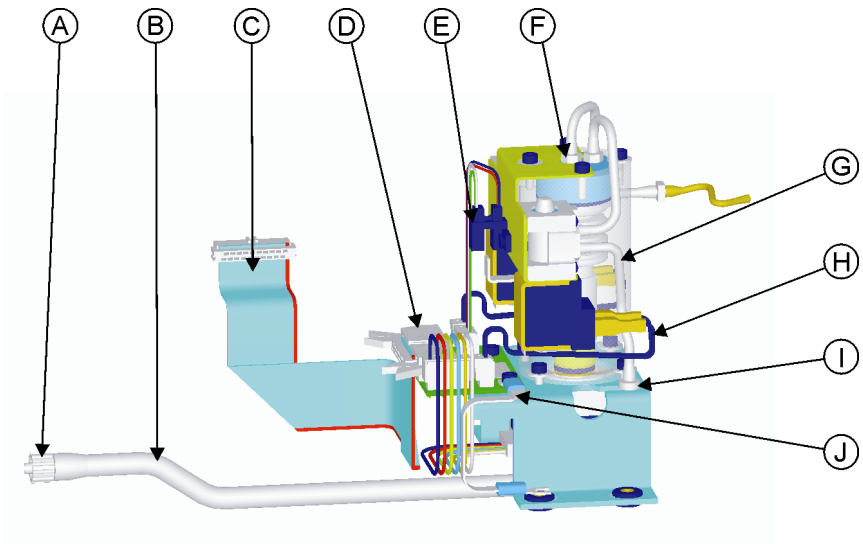
MODULE 3B Pump-unit



	Part number	Item	Amount
A	3066-147	Male luer connector	1
B	1513-024	Tube, PVC 4 x 8 mm (1 m)	1 x 240 mm
C	3374-103	Pump cable	1
D	6002-342	Pump board assy	1
E	6002-332	Opto assembly	1
F	3066-138	Connector 10-32 UNF	2
G	1513-052	Tube, PVC 1.5 x 3.5 mm clear (5 m)	1 x 68 mm
H	6002-333	Valve cable assy	2
I	3066-146	Socket	1
J	3374-112	Earth strap	1

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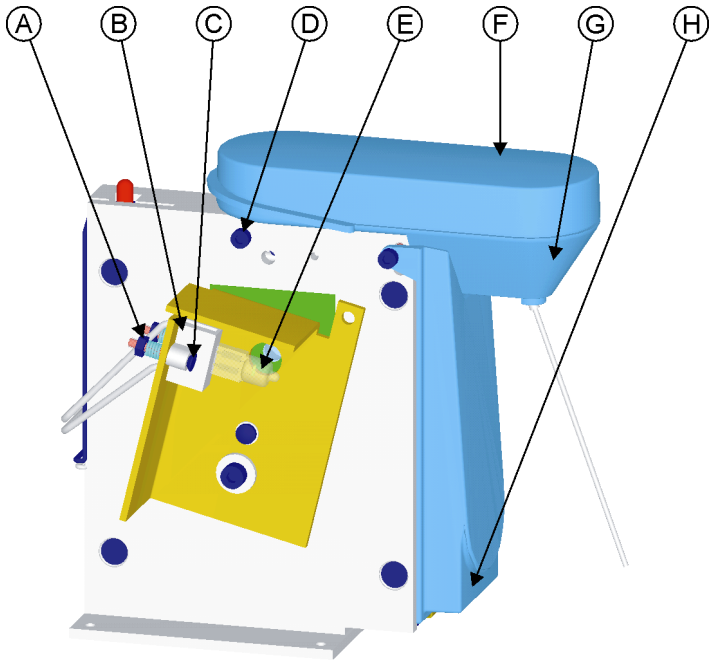
MODULE 4A Optical unit



	Part number	Item	Amount
A	3750-055	Spring	2
B	3350-156	Lamp socket	1
C	3004-216	Screw M 3 x 20	2
D	3002-307	Screw M 3 x 8	2
E	3380-018	Halogen lamp 12 V/20 W	1
F	3070-477	Top sipper housing	1
G	3070-472	Sipper housing	1
H	3070-473	Lever	1

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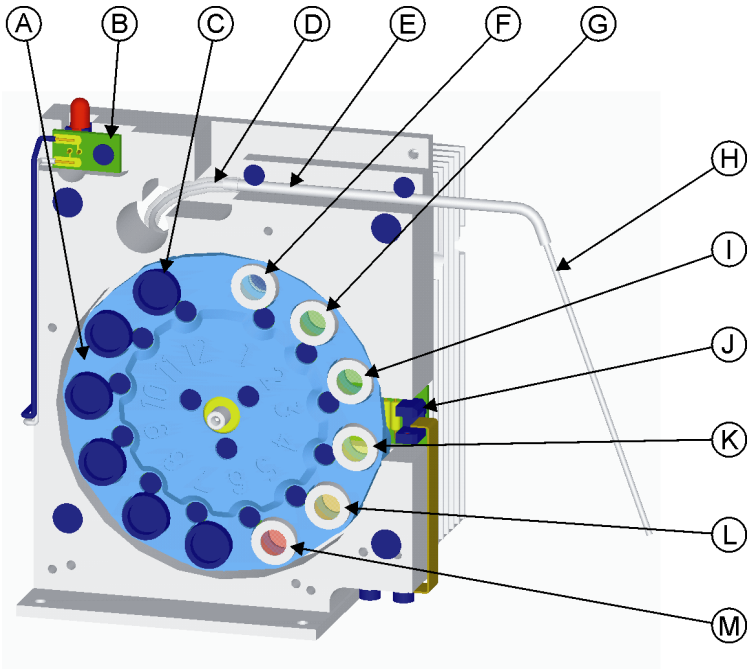
MODULE 4B Optical unit



	Part number	Item	Amount
A	4509-217	Disk	1
B	6002-320	Indicator board assy	1
C	4100-750	Prop	6
D	1513-001	Tube, PVC 2 x 4 mm clear (5 m)	1 x 36 mm
E	4104-118	Pipe	1
F	3067-340	Filter IFL 340 nm	1
G	3067-405	Filter IFL 405 nm	1
H	1503-008	Tube, PTFE 0.7 x 1.6 mm (1 m)	1 x 255 mm
I	3067-505	Filter IFL 505 nm	1
J	6002-321	Opto board assy	1
K	3067-546	Filter IFL 546 nm	1
L	3067-578	Filter IFL 578 nm	1
M	3067-620	Filter IFL 620 nm	1

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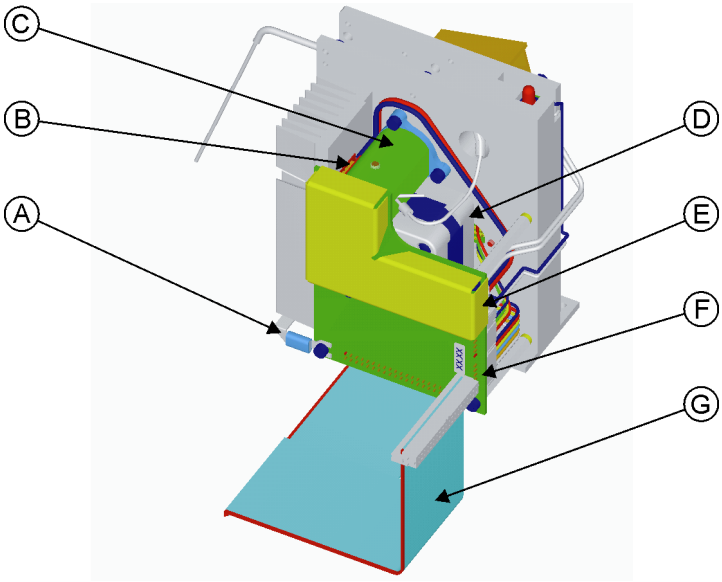
MODULE 4C Optical unit



	Part number	Item	Amount
A	3374-112	Earth strap	1
B	3390-042	Peltier element	1
C	6002-345	House assy	1
D	6002-322	Motor unit	1
E	4801-142	Cover	1
F	3367-054	Photometer board	1
G	3374-104	Photometer unit cable	1

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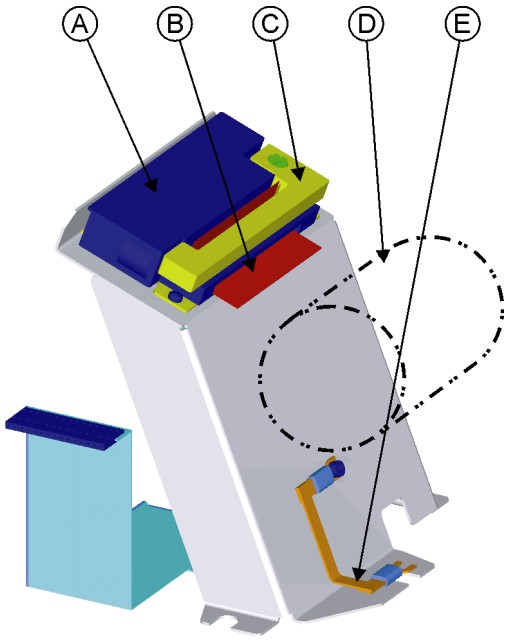
MODULE 5 Printer unit



	Part number	Item	Amount
A	6002-313	Printer	1
B	3074-100	Cable assy	1
C	3073-105	Ink ribbon cassette	1
D	3073-025	Paper roll (indicated)	1
E	3374-112	Earth strap	1

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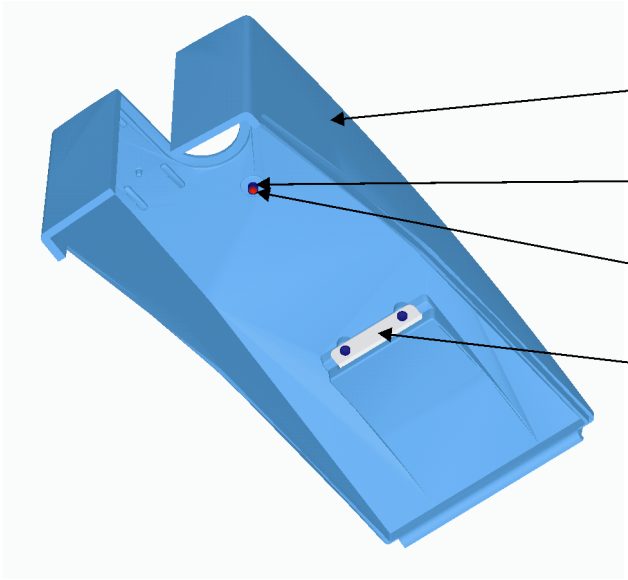
MODULE 6 Service cover



	Part number	Item	Amount
A	3070-479	Service cover	1
B	3380-354	Grommet	1
C	3380-353	Light tube	1
D	4802-422	Cutter	1

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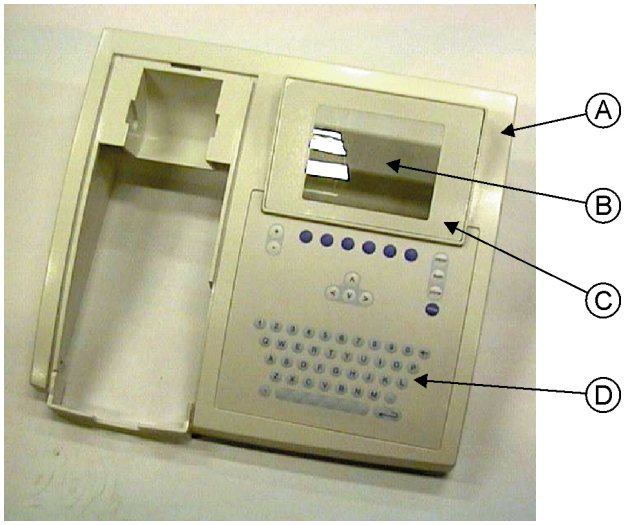
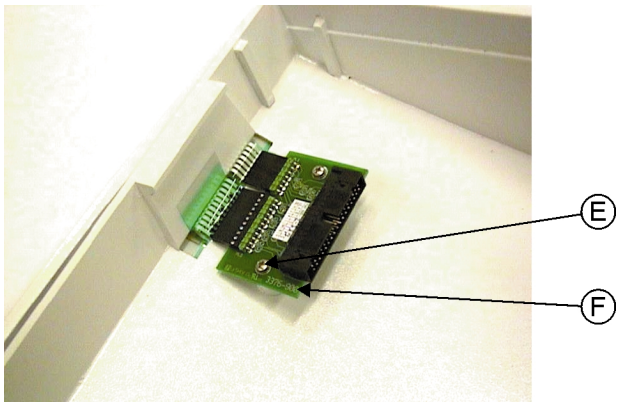
MODULE 7A Top cover



MODULE 7B Top cover



	Part number	Item	Amount
A	3070-480	Top cover	1
B	3059-017	Window	1
C	3820-406	Display sticker (standard version)	1
D	3342-855	Keyboard	1
E	3002-224	Screw 3 x 8	2
F	6002-339	Keyboard interconn. board	1

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Appendix

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A.1 Target Host Communication

The Target-Host communication for the Micro Series is divided into a number of layers. This chapter offers a description of these layers in the model:

- Serial interface design.
- Physical layer including pin assignments etc.
- Packet layer including packet type field definition.
- Heartbeat mechanism including protocol usage.
- Message layer including header definition.
- Application layer including.

A.1.1 Serial interface design

Figure 1 offers an overview of the layers in the model.

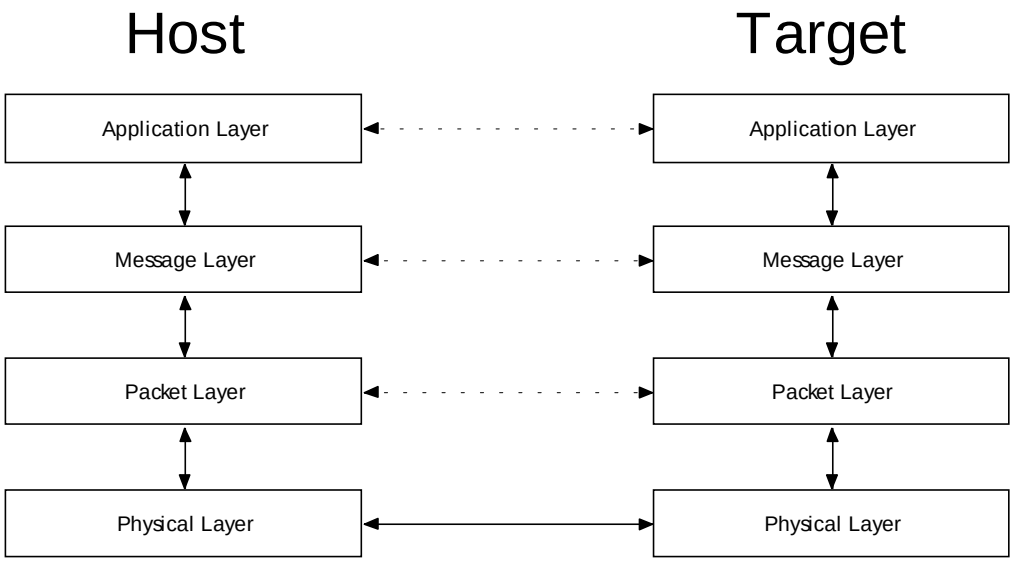

Figure 1: Communication Layer Model

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A.1.1.1 Physical layer

The physical layer is used to transfer bytes between target and host. This is achieved by means of an RS232 interface. The target is supplied via a 9-pins DB9 male connector. The connections are shown in the following table:

Pin	Signal	In/Out (from point of view of the Target)
1	DCD	In
2	Rx	In
3	Tx	Out
4	DTR	Out
5	GND	-
6	DSR	In
7	RTS	Out
8	CTS	In
9	RI	In

Table 1: Pinning of the Host DB9 male connector

Only the Rx and Tx signals are used to transfer bytes between target and host. There will be no hardware handshaking between target and host.

The baud rate is **fixed at 9600 Baud**. Bytes are transferred with 1 start bit, 8 data bits, 1 stop bit and no parity bit.

In order to connect a PC Host to the target, a simple NULL-modem (crossed Rx/Tx signals) cable is sufficient.

The signal levels comply with the RS232 specification. The cable length between Target and Host is specified as being less then 10 meters.

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A.1.2 Packet layer

The packet layer offers reliable and error-free packet transfer across the connection. It implements error detection and recovery on packet level, so the message layer is assured that packets sent reach the other side without corruption, and also that incoming packets are not corrupted.

A packet consists of a number of bytes. Its format is:

Header (1 byte 0xFF)	Length (1 byte)	Type (3 bits)	ID (5 bits)	Data (n bytes)	Checksum (1 byte)

The Header byte is defined as hexadecimal value 0xFF. The next field consists of a byte indicating the number of bytes in this packet **after** the length field, including the checksum byte. This defines the maximum packet size to 257 bytes. The Data field is at most 253 bytes.

The type field indicates the contents of the packet. This is either:

Type bits	Description
000	**data** packet containing n bytes of message data in the Data field.
001	**ACK** packet, acknowledging a previously received data packet. The Data field is empty.
010	**NACK** packet, indicating an error in a previously received data packet. The Data field is empty.
011	**Heartbeat Request** packet, used for communication status polling. The Data field is empty.
100	**Heartbeat Acknowledge** packet, used for communication status polling. The Data field is empty.
101	Reserved. Do not send a packet with this type. Ignore received packets with this type.
110	Reserved. Do not send a packet with this type. Ignore received packets with this type.
111	Reserved. Do not send a packet with this type. Ignore received packets with this type.

Table 2: Packet Type field definition

The ID is a modulo 32 number identifying a data packet. This is used on the target side to notice multiple transmissions of the same data packet. In case of ACK or NACK, the ID field is set to 0.

If a packet is a data packet, n bytes of data reside in the data field. The number of bytes of the data field is calculated as: n = Length - 2

If it's an ACK or NACK packet, the Data field is empty.

Finally, a checksum byte is added. The checksum is a modulo 256 addition of all packet bytes following the header byte till the checksum byte, subtracted from 256. Therefore, the sum of all bytes following the header including the checksum byte must be zero.

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The following tables show the usage of the packet protocol under several conditions:

A: The data packet #0 is received correctly at the target, and the ACK is received correctly at the host.

B: The data packet #1 is corrupted, so a NACK is returned. The host responds with a retry, which works correctly.

C: The host sends a data packet #2, but it never reaches the target. After a time-out period, if still no ACK or NACK has been received, the host does a retry.

D: A data packet #4 is received correctly at the target, which responds with an ACK. However, the ACK doesn't reach the host or becomes corrupted. After a time-out period, the host responds with a retry of data packet #3. The target receives another data packet #3, which is **not** sent to higher level software because it already received a correct data packet #3. The receiving is acknowledged to the target, though.

When a value 0xFF within a packet is falsely seen as a packet header, the packet Layer will recover from this error by means of the packet timeout or a checksum failure: The receiver expects a number of bytes determined by the byte received after the 0xFF. If the receiver expects too many bytes, a packet timeout will occur after the sender has sent the last byte of the packet. If the receiver expects the exact amount or less bytes than the remaining bytes in the current packet, a checksum failure occurs, and the receiver will wait for the next packet header.

A number of parameters must be determined:

Packet time-out: This is the maximum time between the first bytes of a packet (0xFF) and the last byte of a packet. The receiver starts a timer when the header byte is received. The complete package must be received before expiration of the timer. If the timer expires before packet completion, a packet time-out has occurred and another start-of-packet is awaited. (The bytes received so far are ignored.)

The value chosen for the packet time-out is **1 second.**

This mechanism will prevent a system lock-up when the serial connection is lost in the middle of a packet transfer. reported to higher software levels.

Ack/Nack time-out: This is the maximum time that is waited for an ACK or NACK packet after sending a data packet. If after this time no ACK or NACK is received, a retry is performed. The value chosen for the Ack/Nack time-out is **2 seconds**.

Packet maximum retries: This is the maximum number of consecutive retries for sending packets. If this number is exceeded, a communication error is reported to the message layer.

The maximum number of packet retries is set to **5**.

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A.1.2.1 Heartbeat mechanism

The packet layer on the target will implement a mechanism to detect the availability of a logical connection to a packet layer on a host. It will do so by sending ‘heartbeat request’ packages at a certain time interval (Heartbeat Frequency). A packet layer on the host must respond within a certain timeout (Heartbeat Timeout) with a ‘heartbeat acknowledge’ packet. If the host responds in time, the logical connection is available. If no response is received, or not in time, a logical connection is not available.

The Heartbeat Frequency is set to ‘one heartbeat per seconds’. The Heartbeat Timeout is set to 5 seconds.

A host can use the same mechanism to detect the availability of the target.

The host is also allowed to send a ‘heartbeat request’ package to the host in order to detect the presence of the target. The target will respond with a ‘heartbeat acknowledge’ as soon as it receives a request.

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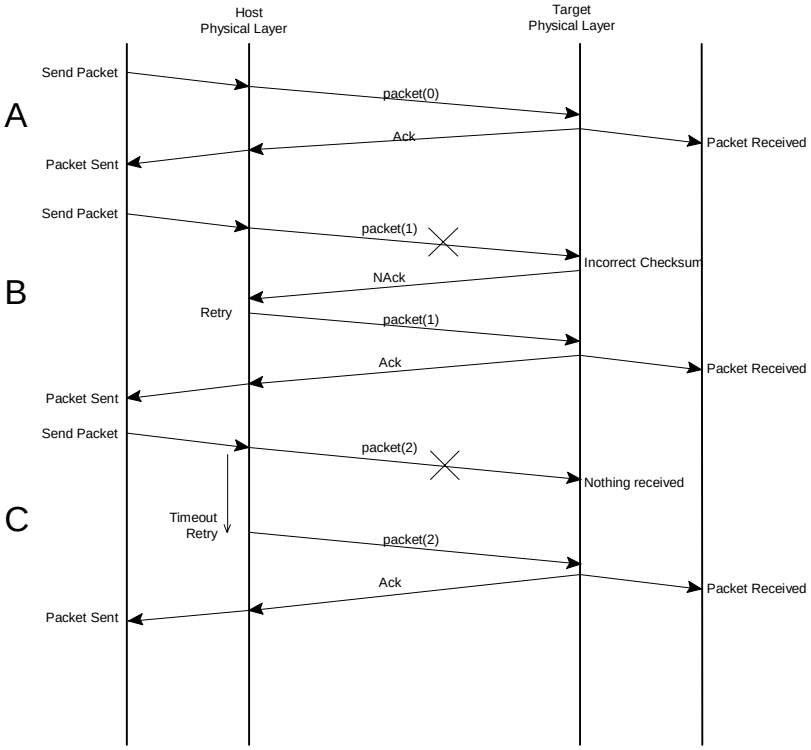

Figure 2: Packet Protocol usage (1)

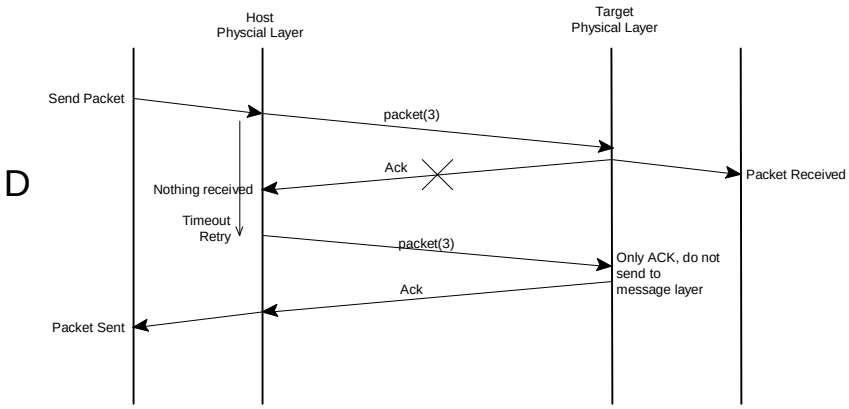

Figure 3: Packet Protocol usage (2)

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A.1.3 Message layer

The message layer provides a way for the application layer to send and receive messages of random length. The message layer cuts outgoing messages into packets and sends them across the connection by means of the packet layer. The message layer concatenates incoming packets to form a complete message. This is shown in Figure 4.

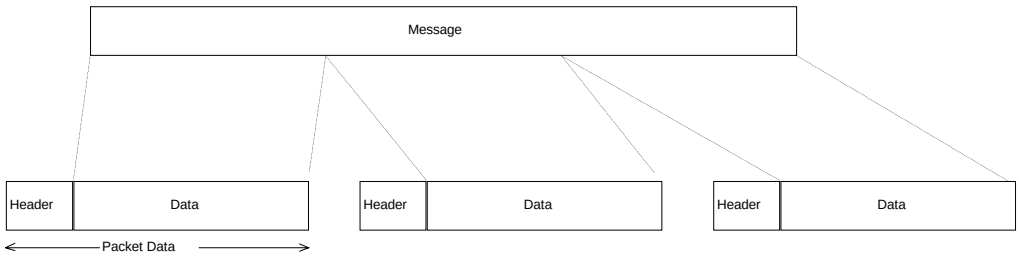

Figure 4: Message to multiple packet transformation

The target is capable of receiving a message that consists of 1 packet maximum. This sets the maximum message size to 252 bytes. This is sufficient for all the application messages used by the target.

A 1 byte header is added to the message data in a packet before it is sent. This header indicates if it is the first packet, an intermediate packet or the last packet of the message. While receiving messages, this information is used to detect start and finish of the message.

Header definition:

Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Last packet of message	First packet of message

If a message fits into one packet, this will be both the first and last packet of the message. A packet is an intermediate packet when neither of the two bits is set. The reserved bits must be set to 0 when a packet is sent.

If transmission of one of the packets fails (even after retries), the transfer of the message is aborted and an error reported to the application layer. (The message layer does not perform retries, since a retry-mechanism is available on the packet layer.)

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A.1.4 Application layer

The application layer sends and receives application messages through the message layer. On the application layer level, the FUMO acts as a slave to the host. It will not autonomously send application messages to the host. It will only send application messages in response to application messages from the host. (The one exception is the HOS_setStatus message that is sent to the FUMO whenever the state of the FUMO changes and when it is subscribed.)

A.1.5 Interface description

A.1.5.1 Glossary of terms

(U)Int16 (Unsigned) integer (16 bits)

(U)Int32 (Unsigned) long (32 bits)

UCString A string of unicode characters. Each unicode character is represented as a UInt16. A UCString will always be send in the following way:

1. length of string in first byte.
2. all unicode characters in UCString (except null-termination), where the first byte is MSB and second byte is LSB of the UInt16.

A.1.5.2 Response classification

HOS_OK = 0x00	Request was successfully received and processed.
HOS_FAILURE = 0x03	Request was not successfully received or processed.

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A.1.5.3 HOS-Target events

Event Description

Event name	Primitive	Description	Destination
HOS_sendReport	0x04	This message will automatically send a measure report to the host if the Micro Series user has selected the auto report system parameter. The host must respond with the related message, before the instrument can continue its work.	host
HOS_SendErrorList	0x09	This message will be sent to the host if the Micro Series user presses the function key HOST (F2) in the error list window. The host must respond with the related message, before the instrument can continue its work.	host
HOS_ConnectMessage	0x0A	This message brings the target in connection state.	target
HOS_SendReportOK	0x84	Reports to the target that the measure report is received on the host. (Response message to the **HOS_sendReport** event)	target
HOS_SendErrorListOK	0x89	Reports to the target that the error list has been received by the host. (Response message to the **HOS_SendErrorList** event)	target

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Parameter Description

All order of data values in the message is the same as the order in the table below. No gap(s) may be created between the bytes. Column “Byte size” uses some simple symbols for short notation:

‘->‘ means ‘up to’

‘#’ means ‘Number of’

Event name	Byte size	Data values	Data description
HOS_sendReport	**1**	**0x04**	**Primitive**
	1	0x00 or 0x06	No. of unicode characters in serial number string.
	0 –> (# chars*2)	UCString characters	Unicode string of serial number.
	1	0x00..0x03	Measure type 0 = REAGENT BLANK 1 = CALIBRATION 2 = CONTROL 3 = SAMPLE.
	1	0..0x08	No. of unicode characters in test name string.
	0 –> (# chars*2)	UCString characters	Unicode string of test name.
	In case of CALIBRATION		
	1	0x00…0xFF	No. of unicode characters in calibration name string including the current calibrator number.
	0 –> (# chars*2)	UCString characters	Unicode string of calibration name string including the current calibrator number. Format: <cal.name>(<cal.no.>).
	In case of CONTROL		
	1	0x00…0xFF	No. of unicode characters in current control name string.
	0 –> (# chars*2)	UCString characters	Unicode string of current control name.

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Event name	Byte size	Data values	Data description
	In case of SAMPLE		
	1	0x00…0x14	No. of unicode characters in patient name string.
	0 –> (# chars*2)	UCString characters	Unicode string of patient name.
	1	0x00…0x0A	No. of unicode characters in sample code string.
	0 –> (# chars*2)	UCString characters	Unicode string of sample code.
	In all cases		
	4	-9999 .. 99999 (Int32) (-0,9999 .. 9,9999)	Measured Absorbance (in 0.1 mAbs).
	4	-999999999 .. 9999999999 (Int32) (-99999,999..999999,999)	Concentration.
	1	0x00…0xFF	No. of unicode characters in unit string.
	0 –> (# chars*2)	UCString characters	Unicode string of the unit.
	1	0x00…0xFF	No. of unicode characters in flags string.
	0 –> (# chars*2)	UCString characters	Unicode string of all assigned flags during the related measurement, separated by spaces. See chapter 6, “Performing Tests” in the User’s Manual for a description of the flags.
HOS_SendErrorList	**1**	**0x09**	**Primitive**
	1	0..0xFF	No. of errors.
	10	string with date of error X	Format: DD/MM/YYYY.
	8	string with time of error X	Format: hh:mm:ss.
	2	UInt16	Errorcode. See chapter 9, "Troubleshooting for description of error codes.
	0 – ((# errors–1)*20)	All data of the remaining errors	Each error consumes 20 bytes.

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Event name	Byte size	Data values	Data description
HOS_ConnectMessage	**1**	**0x0A**	**Primitive**
HOS_sendReportOK	**1**	**0x84**	**Primitive**
	1	0x00…0xFF	Result (HOS_RESULT): HOS_OK HOS_FAILURE
HOS_SendErrorListOK	**1**	**0x89**	**Primitive**
	1	0x00…0xFF	Result (HOS_RESULT): HOS_OK HOS_FAILURE

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A.2 Routines

The following flow charts show the order of the tasks performed for the respective routines.

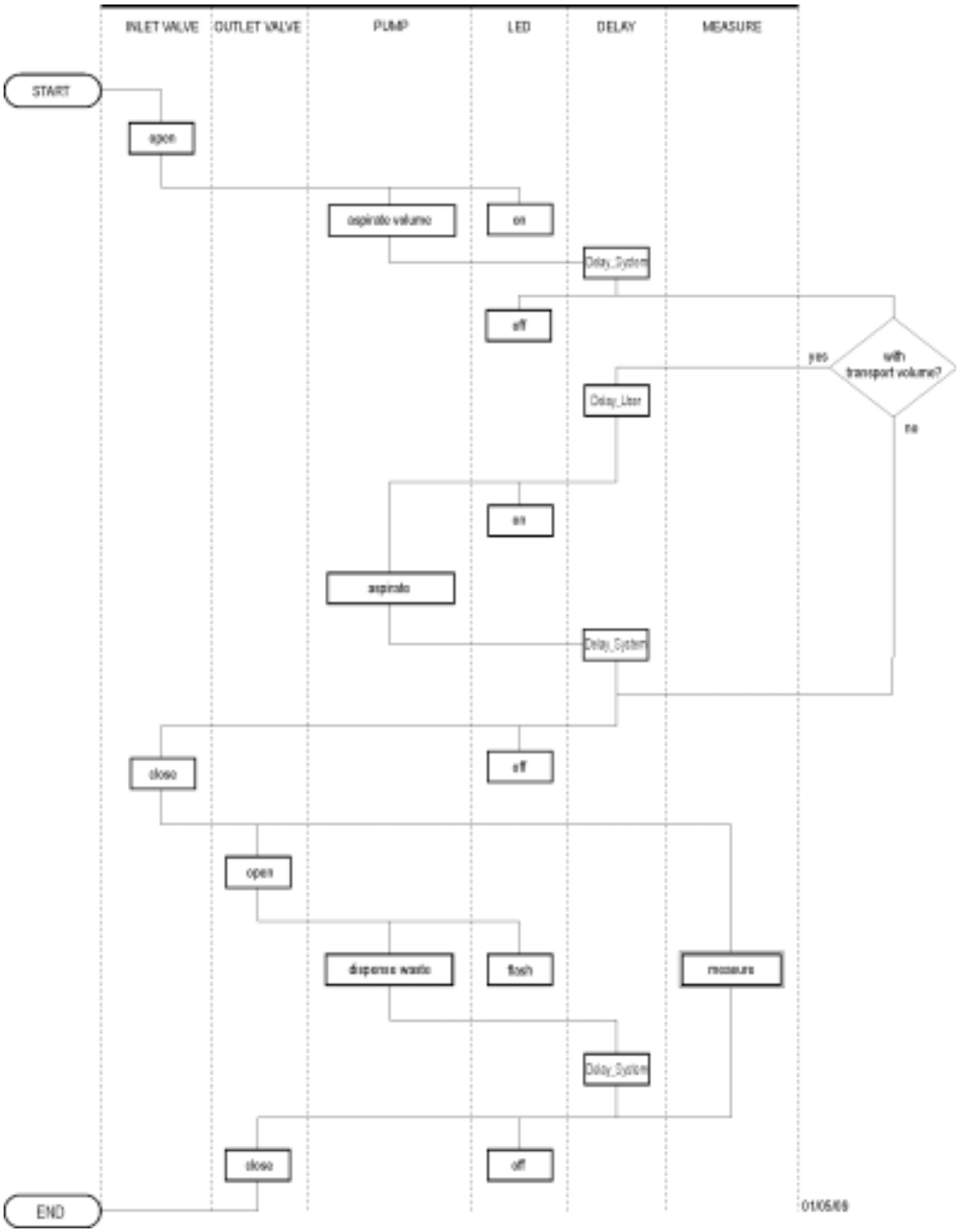

Figure 5: Measure/Prime Routine

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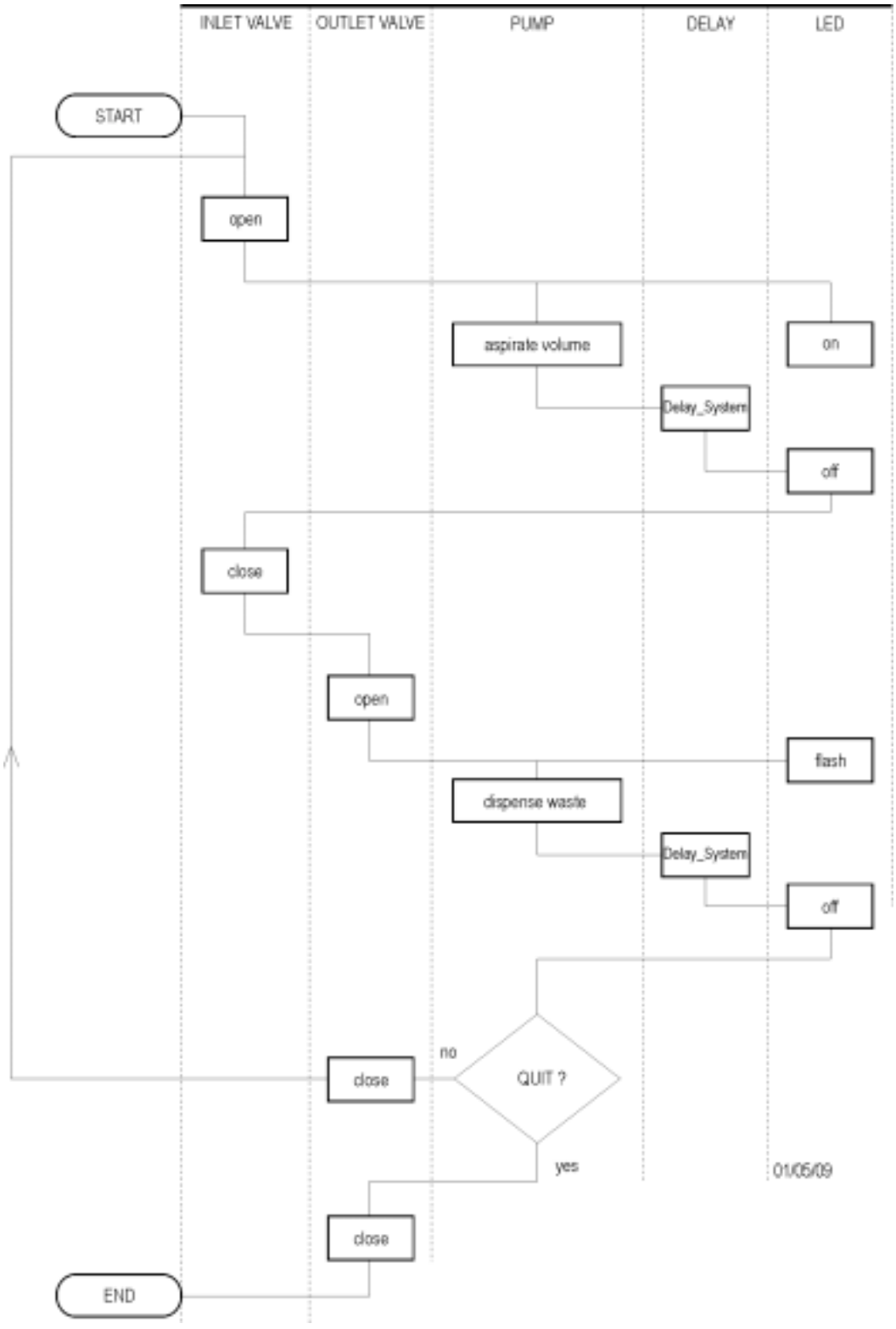

Figure 6: Flush Routine

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A.3 ID PCB

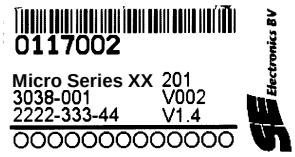
The Micro Series system has 2 Printed Circuit Boards: the processor board and the photometer board. In order to establish proper identification, the PCBs are marked during production by means of a sticker.

The information shown on the stickers is as follows:

A.3.1 Photometer board

There are 2 stickers on this board:

A sticker [A] which contains the Vital codes for the board with a maximum of **11 positions**, (3367-054-XX). XX can be a version. Please refer to the example below.



Sticker A
Scale 1:1 (40 x 20 mm)

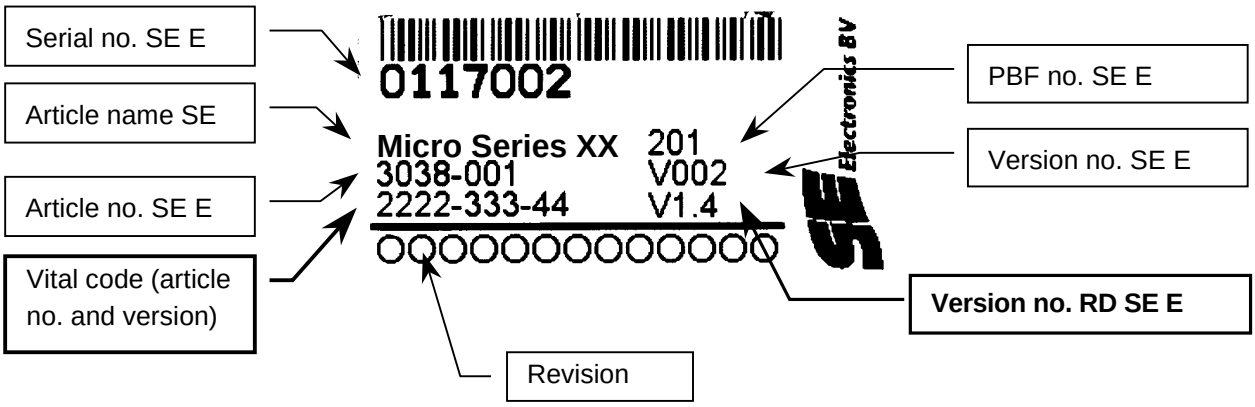


Figure 7: PCB sticker

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The sticker [B] shows the temperature offset of the temp. sensor. It has a total of **5 positions**. Example: +0.50, including the decimal point. The offset can be positive (+) or negative (-). The value is in degrees centigrade °C. The Offset is the deviation from 37.0 °C.

Temperature reference sensor is 37.0 °C.
If sensor (to be calibrated) indicates 36.5 °C then the offset value is -0.50 °C.
If sensor (to be calibrated) indicates 37.3 °C then the offset value is +0.30 °C.

The system needs to be set as follows:
If the offset is "-", the minus sign and the offset value must be entered in the system.
If the offset is "+", only the offset value must be entered in the system, not the plus "+" sign.

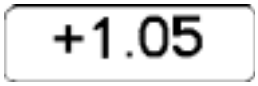

Figure 8: Sticker B
Dimensions: 16 x 5 mm (not to scale)

A.3.2 Processor board

The sticker attached to the main processor board has the same dimensions and content as the sticker on the photometer board; the exception to this being the Vital code that describes a different article and version number.

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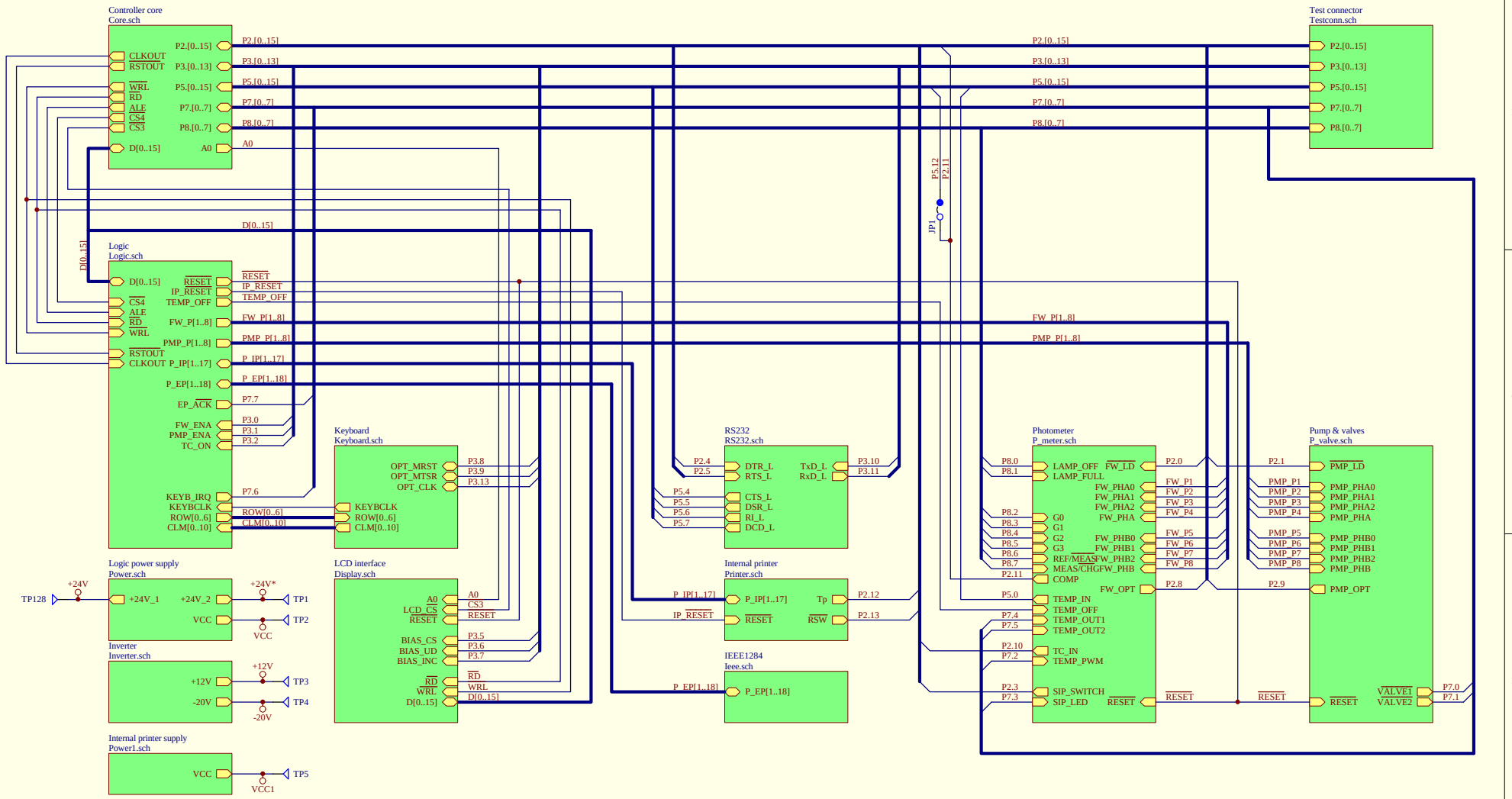
A.4 Electrical Drawings

The electrical drawings are included to assist the service technician in his task. The following table, based on the texts in chapter 6, indicates the drawing and the corresponding number at a glance.

Processor board	1
Microcontroller and logic core	2, 3 and 4
Signal conversion control	5
Sipper interface	5
Filter wheel control	6
Light source control	7
Temperature control	8
Valve control	9
Pump control	10
RS232 Interface	11
LCD interface	12
Matrix keyboard interface	13
PS2 keyboard interface	13
IEEE1284 external printer interface	14
Epson M-180 internal printer interface	15 and 16
Logic power supply	17
24V / -20V Inverter & 12V supply	18
Internal printer Power Supply	19
Test points	20
Signal conversion board	21

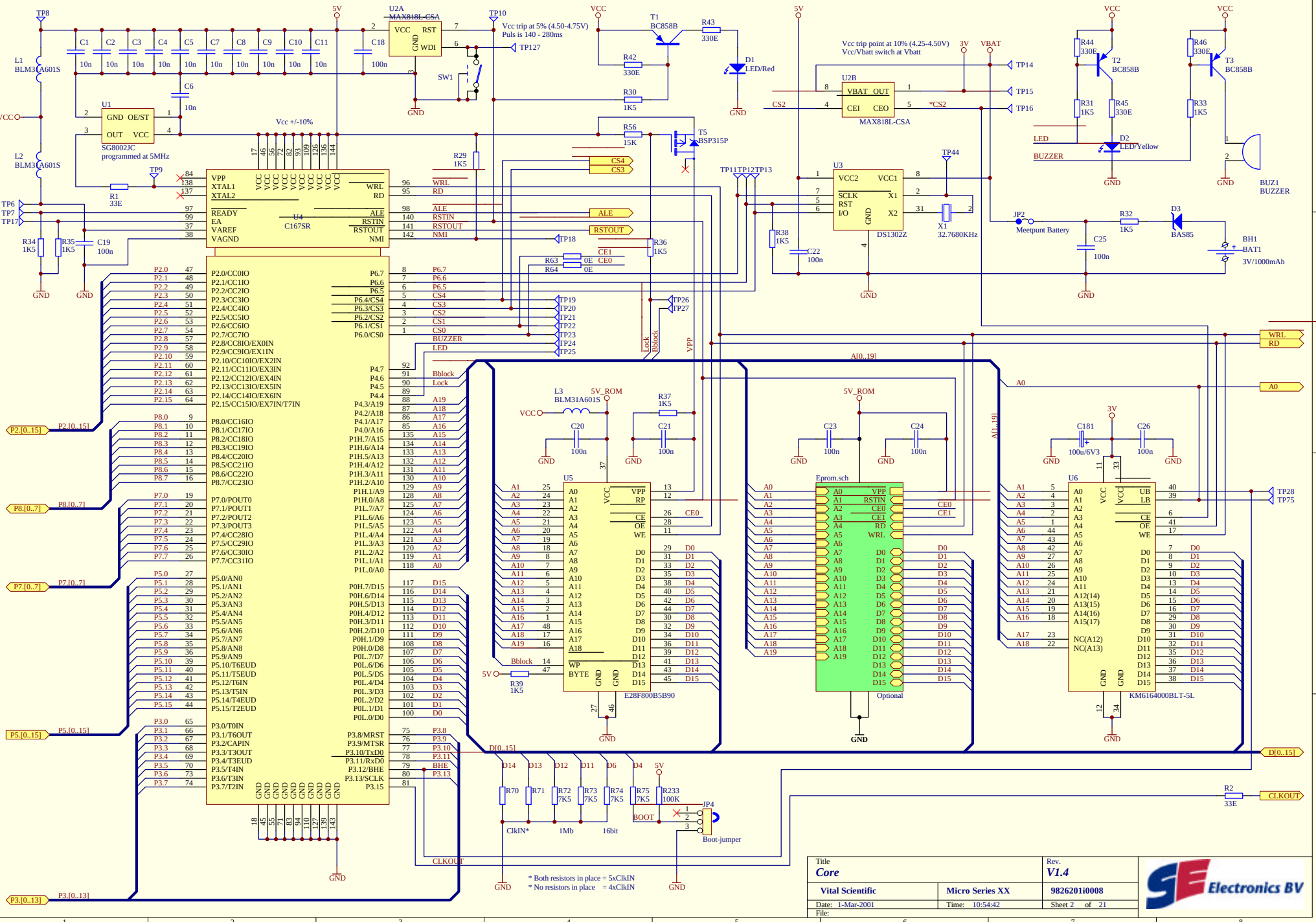
VITAL SCIENTIFIC N.V.

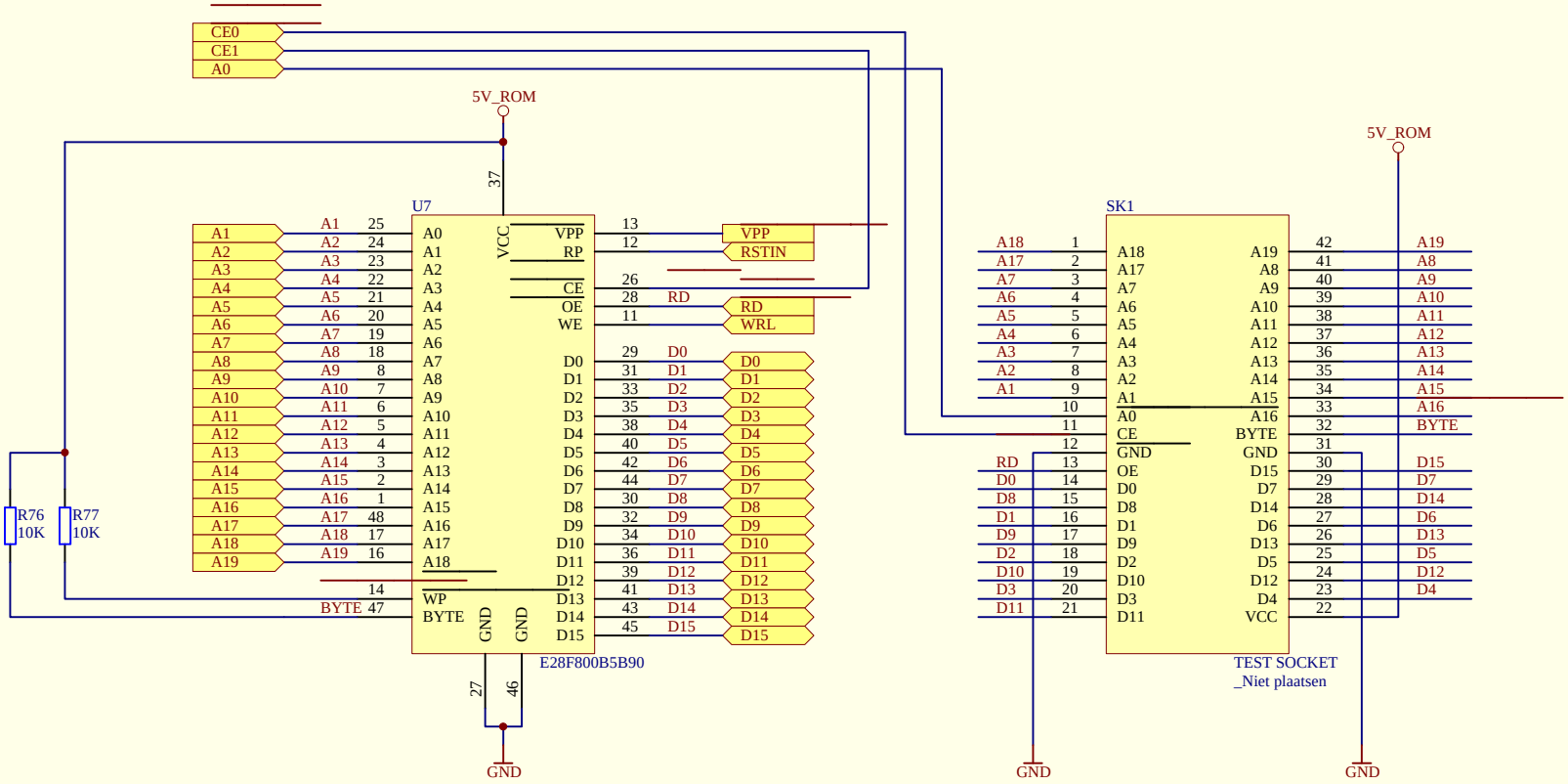


Mounting holes GND **Fiducials**

Title: ***Main board***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**98262011i0008**
Date: 1-Mar-2001	Time: 10:54:34	Sheet 1 of 21
File:		

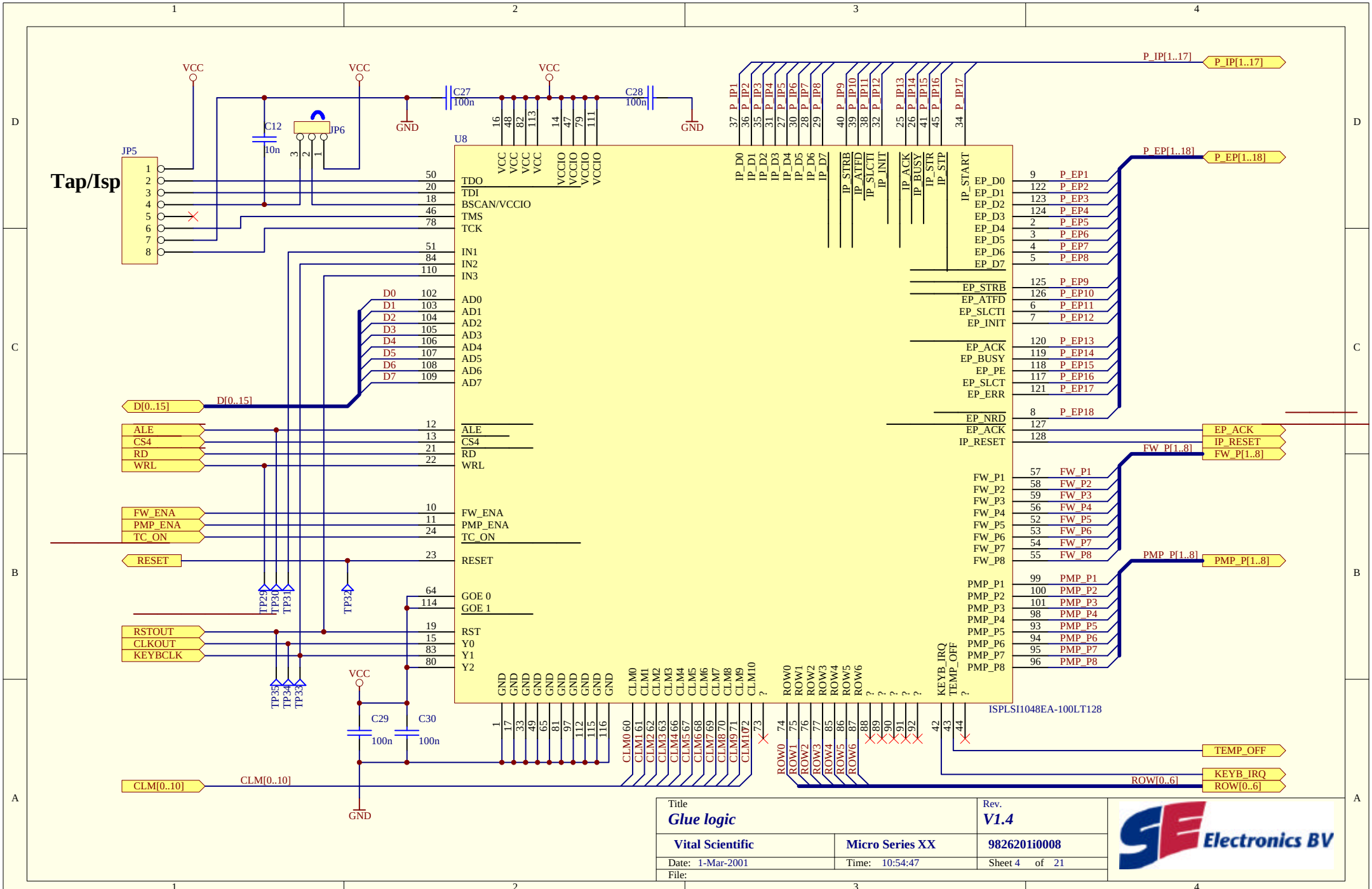
Electronics BV


U2A
MAX818L-CSA
Vcc trip at 5% (4.50-4.75V)
Puls is 140 - 280ms
Vcc trip point at 10% (4.25-4.50V)
Vcc/Vbatt switch at Vbatt
MAX818L-CSA
SG8002JC
programmed at 5MHz
C167SR
DS1302Z
32.7680KHz
Meetpunt Battery
3V/1000mAh
BUZ1
BUZZER
E28F800B5B90
KM6164000BLT-5L
Eprom.sch
Optional
Boot-jumper
* Both resistors in place = 5xClkIN
* No resistors in place = 4xClkIN
Title
Core
Rev.
V1.4
Vital Scientific
Micro Series XX
98262011i0008
Date: 1-Mar-2001
Time: 10:54:42
Sheet 2 of 21
File:
Electronics BV



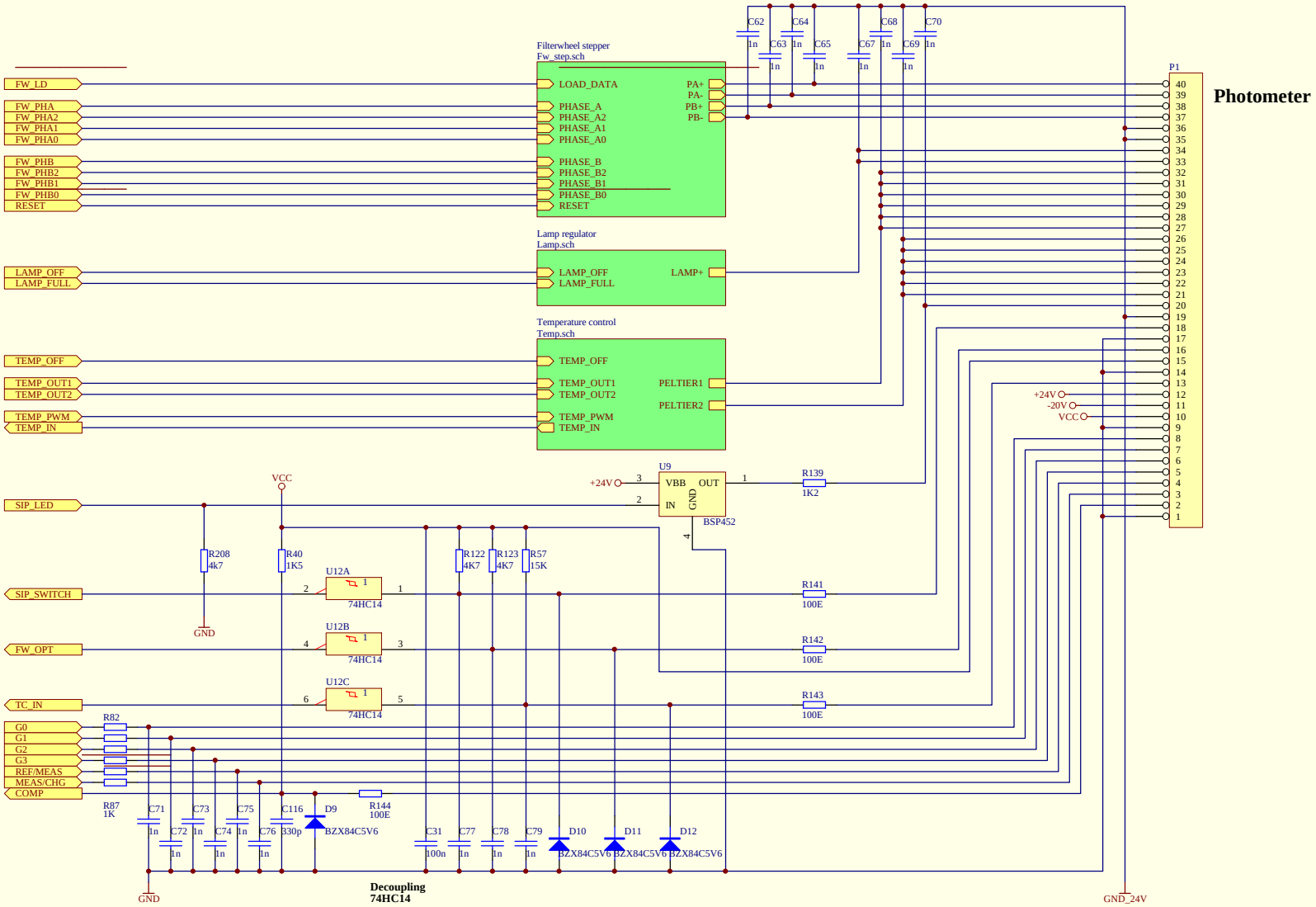
Title: ***Optional FlashROM & Test connector***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:43	Sheet 3 of 21
File:		

SE Electronics BV



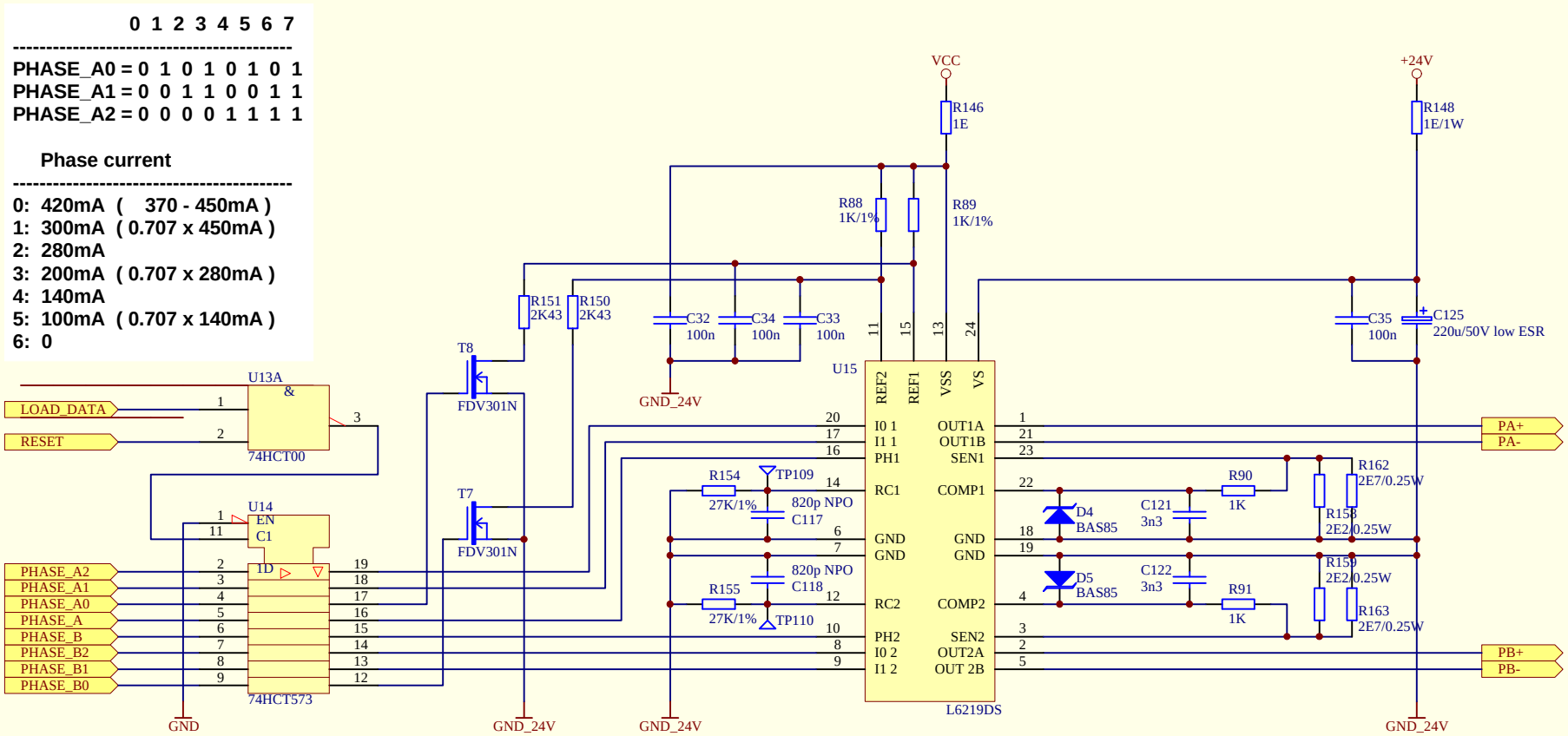
Title: *Glue logic*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:47	Sheet 4 of 21
File:		

SE Electronics BV



Title: ***Photo Meter Unit***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**98262011i0008**
Date: 1-Mar-2001	Time: 10:54:48	Sheet 5 of 21
File:		

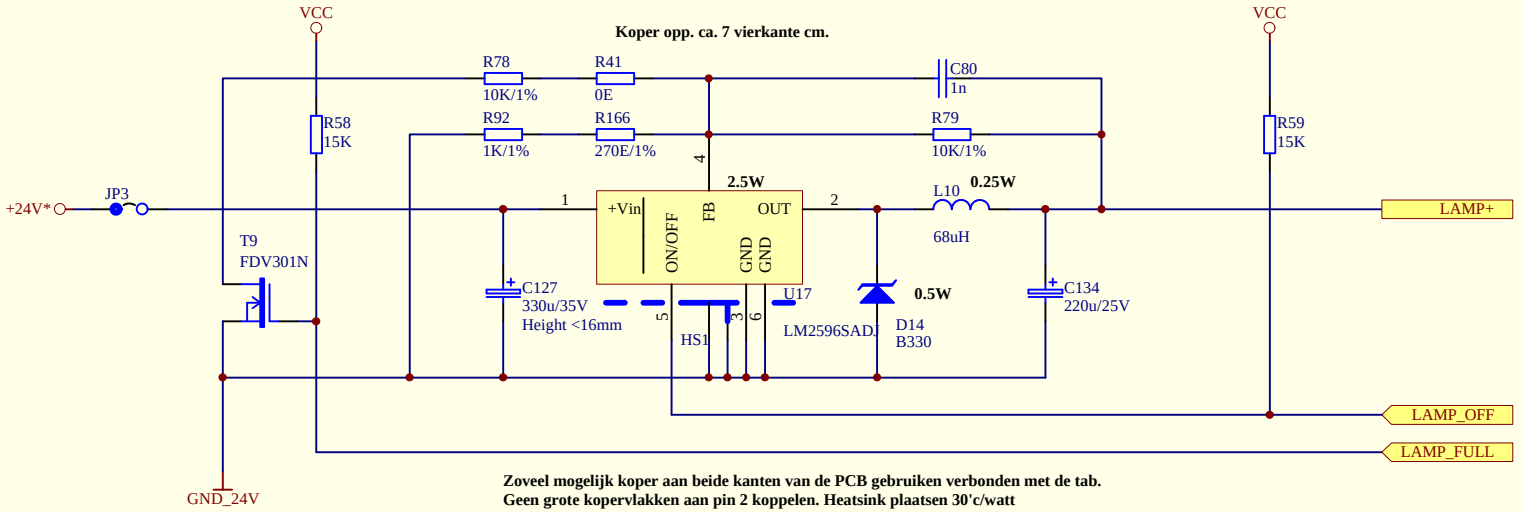
SE Electronics BV



Zoveel mogelijk koper aan beide kanten van de PCB gebruiken verbonden met alle GND pinnen.

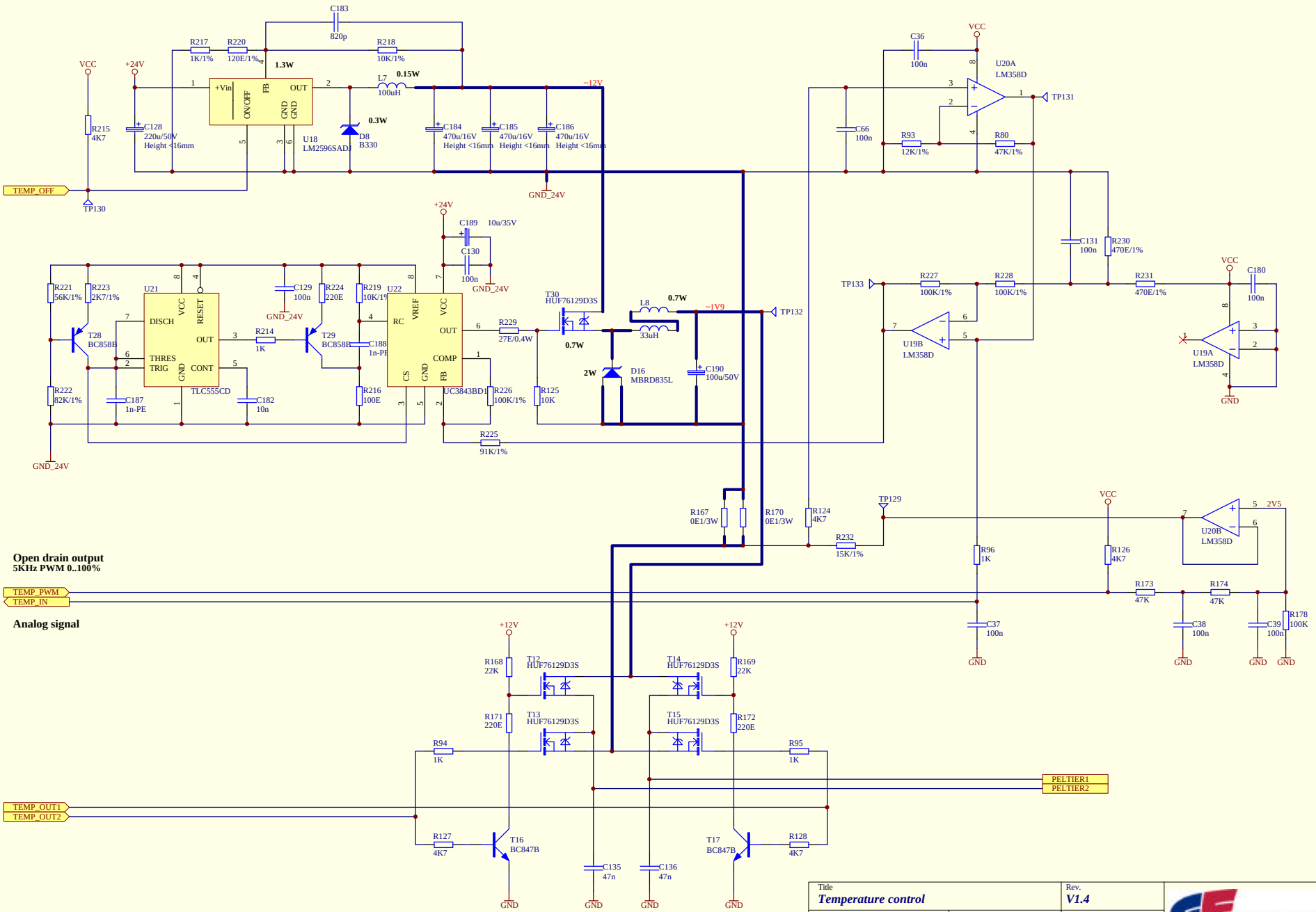
Title: ***Filterwheel stepper driver***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:51	Sheet 6 of 21
File:		

SE Electronics BV



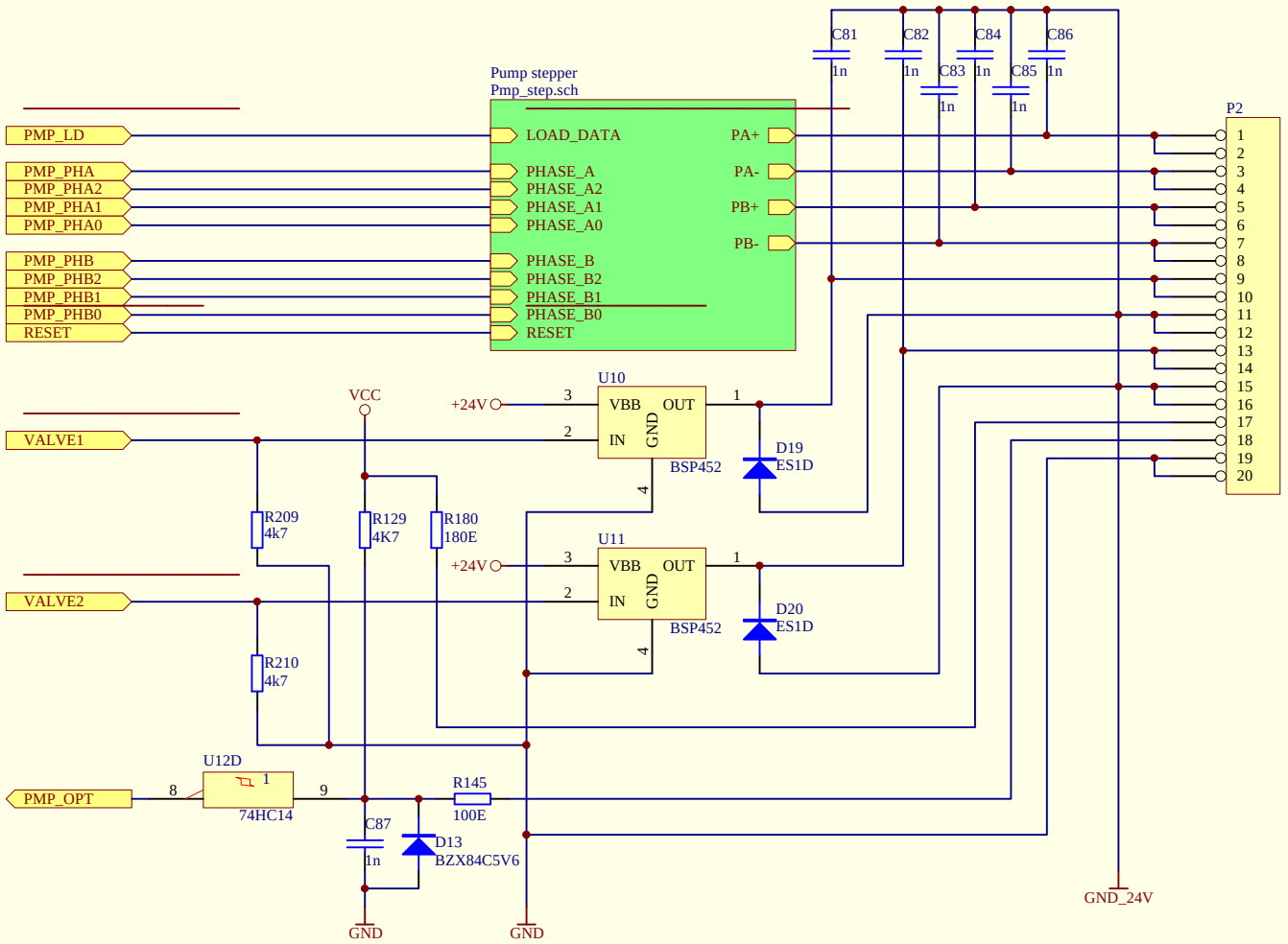
Title: *LAMP Regulator*		Rev.: *V1.4*
Vital Scientific	Micro Series XX	9826201i0008
Date: 1-Mar-2001	Time: 10:54:52	Sheet 7 of 21
File:		

SE Electronics BV



Title: *Temperature control*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**98262011i0008**
Date: 1-Mar-2001	Time: 10:54:53	Sheet 8 of 21
File:		

SE Electronics BV



Pump / Valve Interconnection

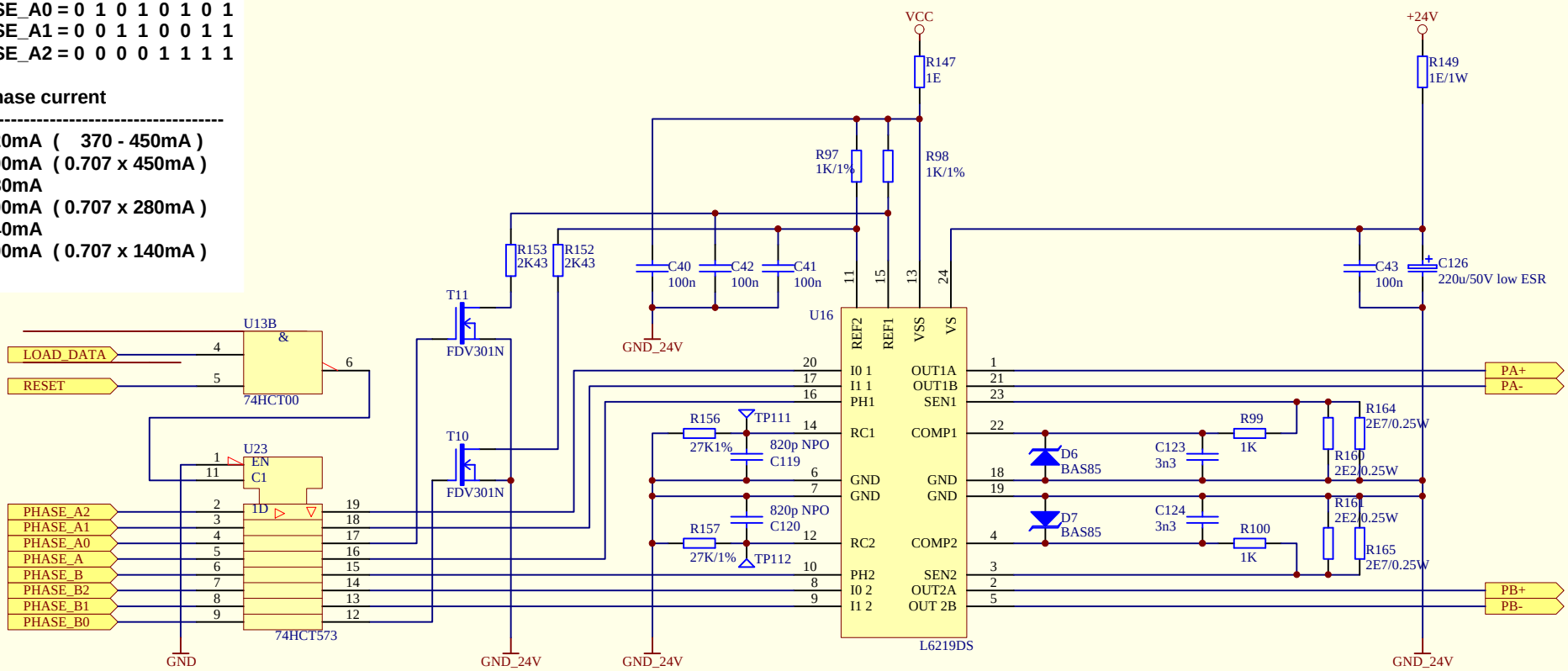
Title: ***Pump and valve control***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:56	Sheet 9 of 21
File:		

SE Electronics BV

	0	1	2	3	4	5	6	7
PHASE_A0 =	0	1	0	1	0	1	0	1
PHASE_A1 =	0	0	1	1	0	0	1	1
PHASE_A2 =	0	0	0	0	1	1	1	1

Phase current

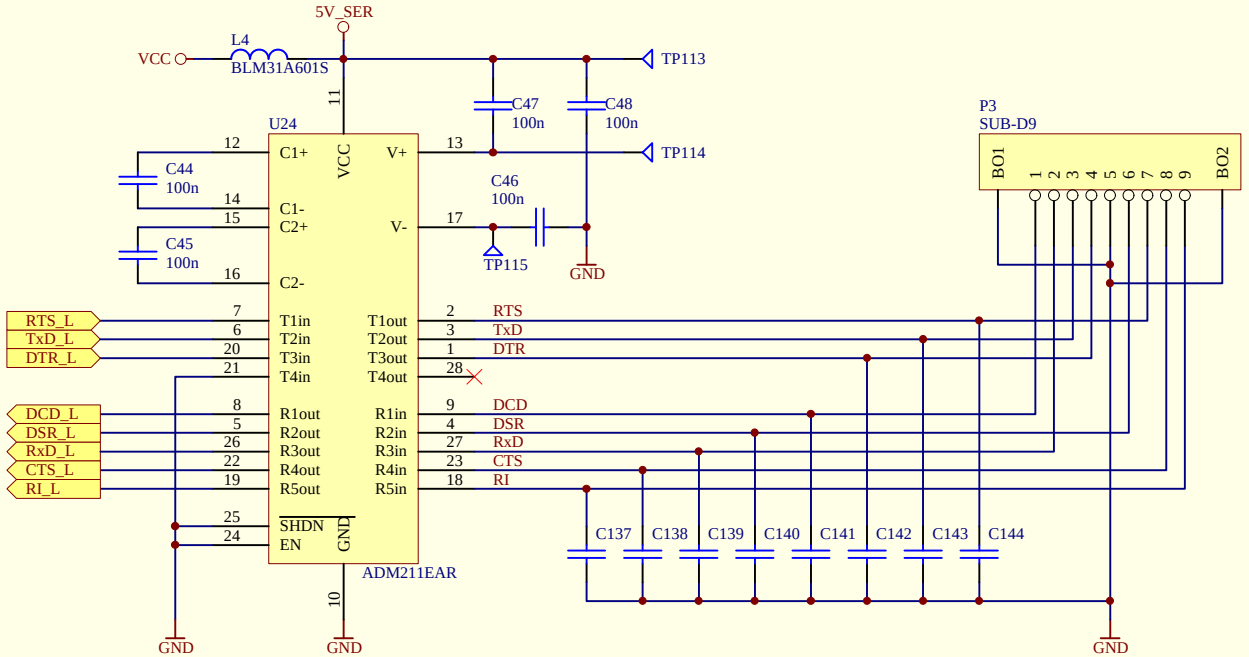
0: 420mA (370 - 450mA)
1: 300mA (0.707 x 450mA)
2: 280mA
3: 200mA (0.707 x 280mA)
4: 140mA
5: 100mA (0.707 x 140mA)
6: 0



Zoveel mogelijk koper aan beide kanten van de PCB gebruiken verbonden met alle GND pinnen.

Title: ***Pump stepper driver***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:58	Sheet 10 of 21
File:		

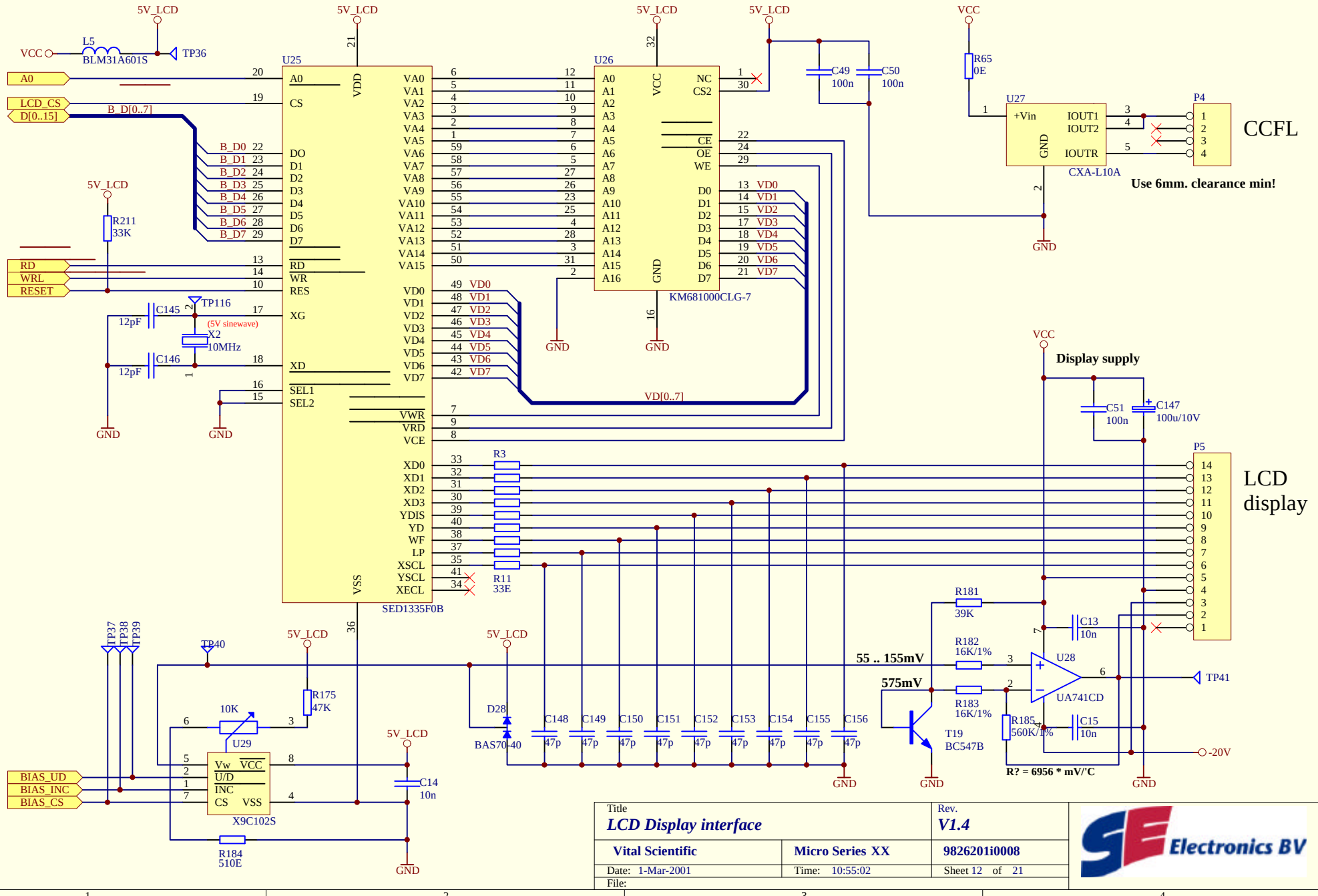
SE Electronics BV



DTE, RS232

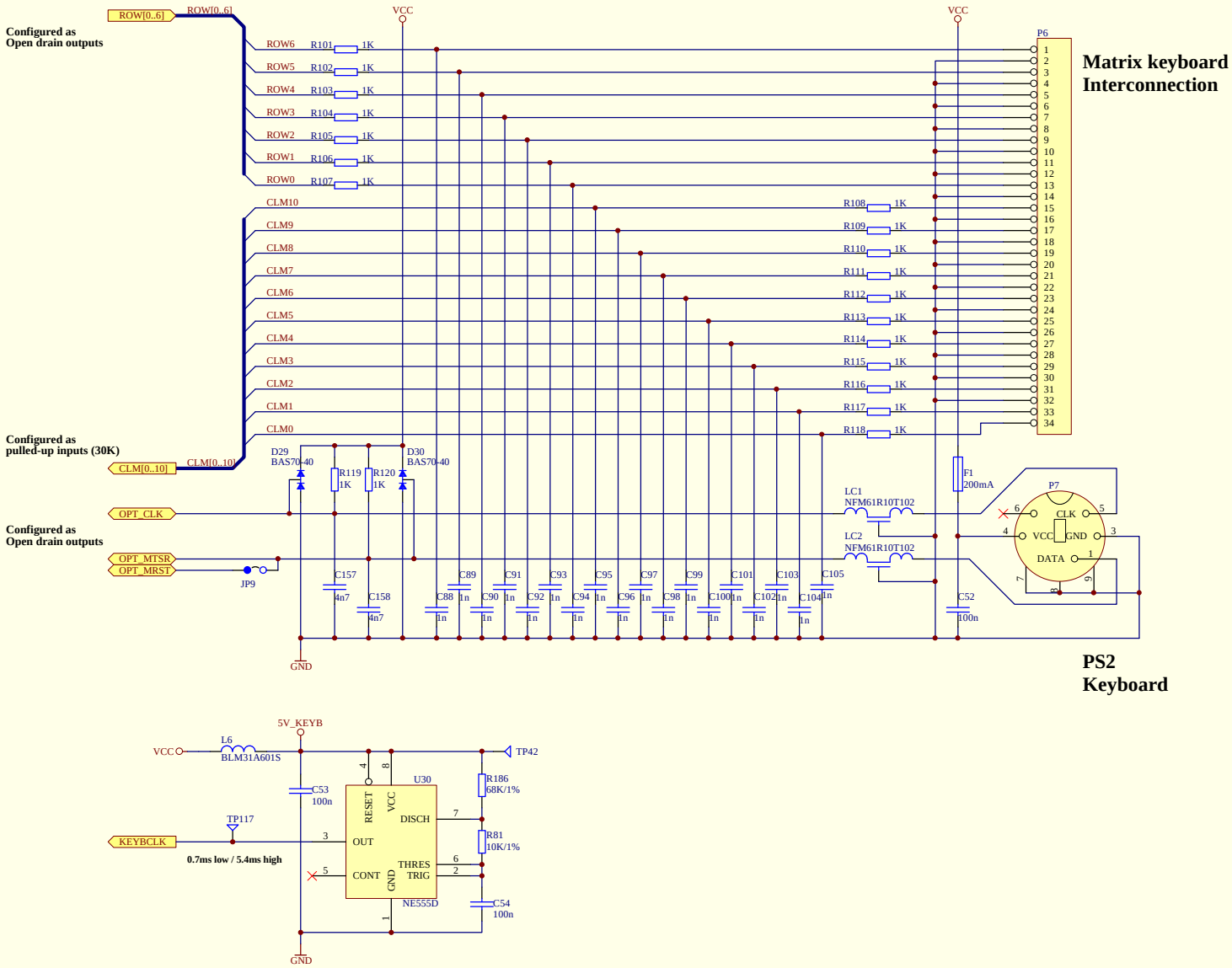
Title: ***RS232 Interface***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:59	Sheet 11 of 21
File:		

SE Electronics BV



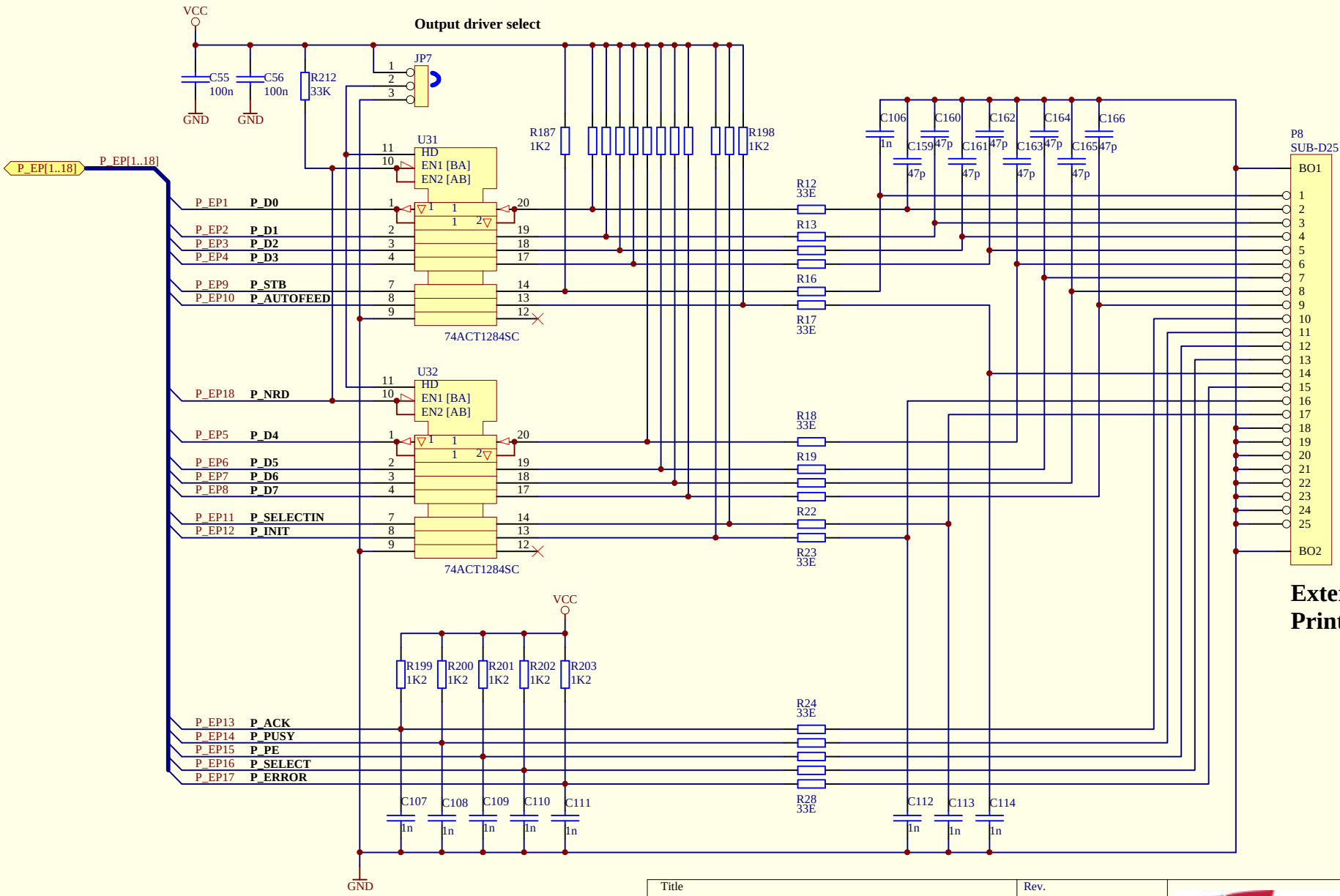
Title: *LCD Display interface*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:55:02	Sheet 12 of 21
File:		

Electronics BV



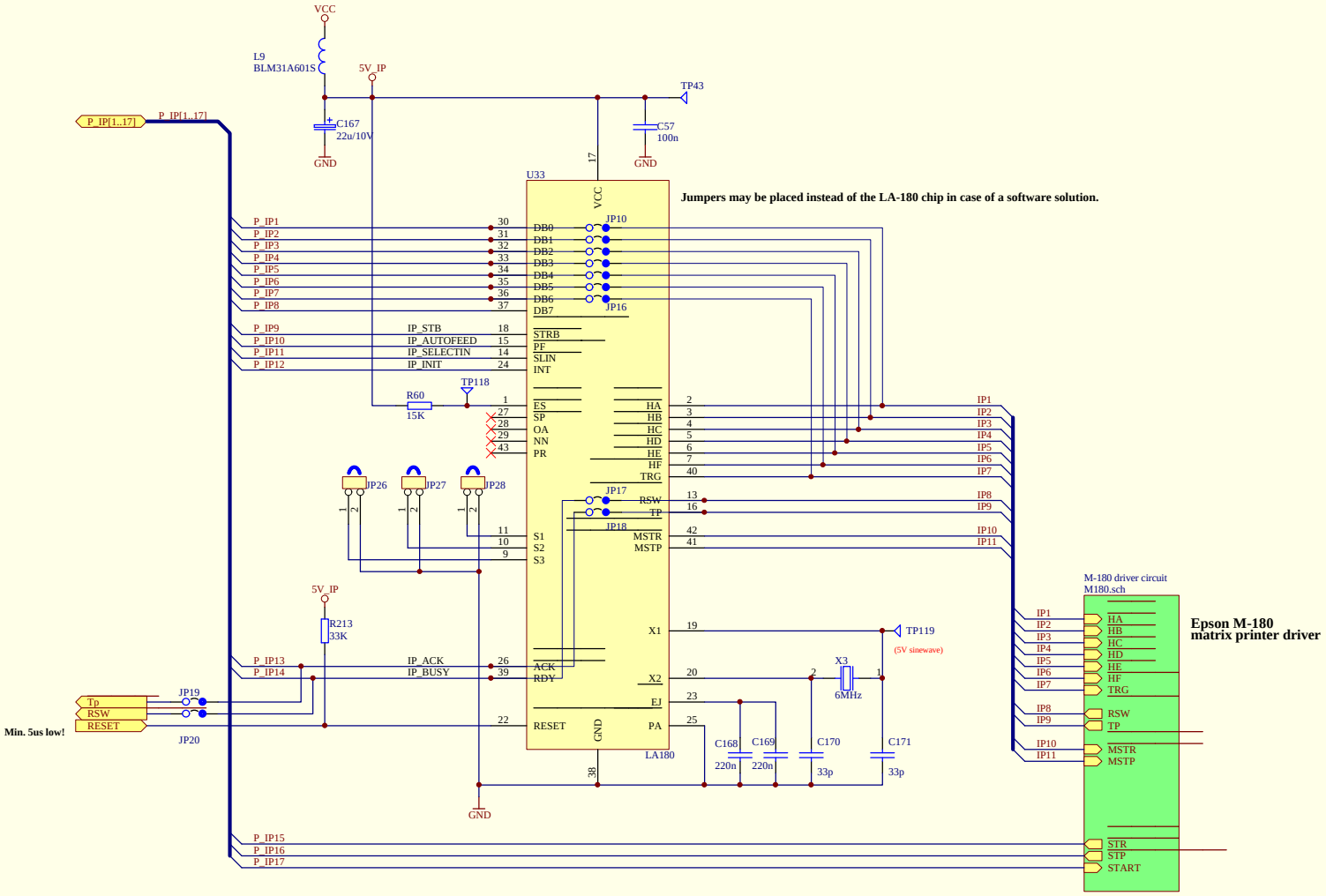
Title: *Keyboard interface*		Rev.: *V1.4*
Vital Scientific	Micro Series XX	98262011i0008
Date: 1-Mar-2001	Time: 10:55:03	Sheet 13 of 21
File:		

Electronics BV



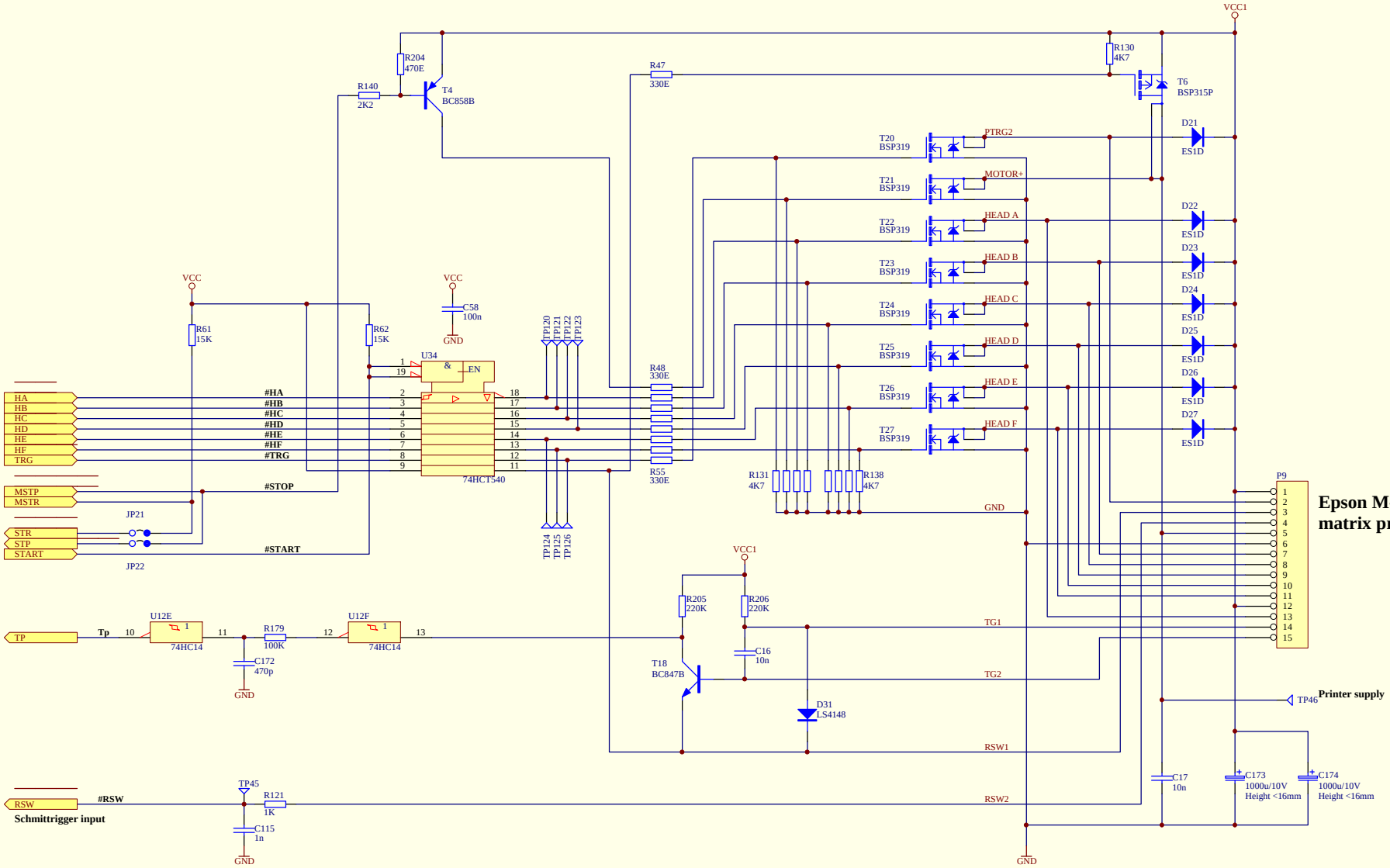
Title: *External printer interface*		Rev.: *V1.4*
Vital Scientific	Micro Series XX	9826201i0008
Date: 1-Mar-2001	Time: 10:55:06	Sheet 14 of 21
File:		

SE Electronics BV



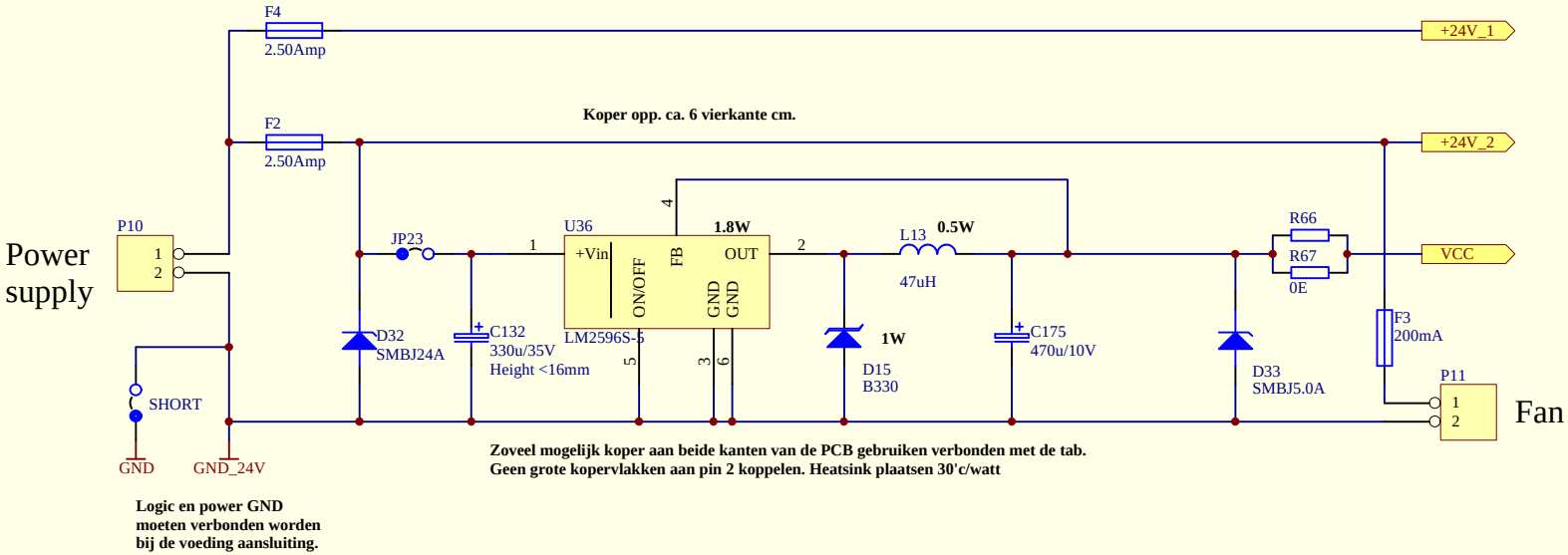
Title: *Internal printer interface, controller*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**98262101i0008**
Date: 1-Mar-2001	Time: 10:55:08	Sheet 15 of 21
File:		

Electronics BV



Title: *Internal printer interface, driver*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**98262101i0008**
Date: 1-Mar-2001	Time: 10:55:10	Sheet 16 of 21
File:		

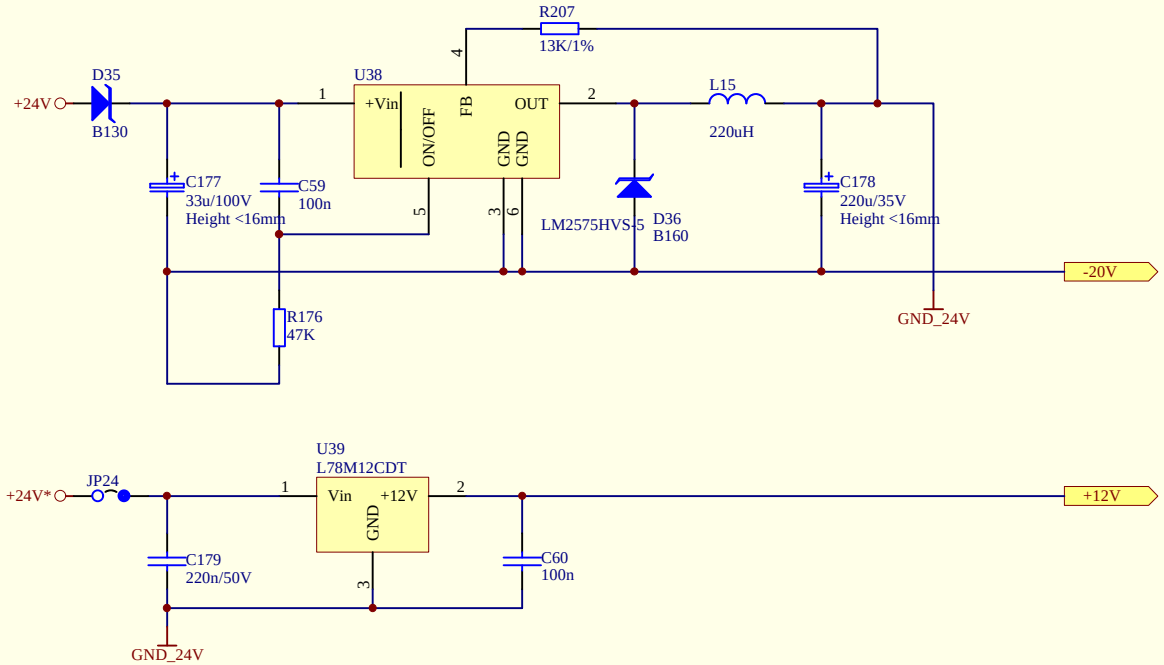
SE Electronics BV



Title: *Logic Power Supply*		Rev.: *V1.4*
Vital Scientific	Micro Series XX	9826201i0008
Date: 1-Mar-2001	Time: 10:55:12	Sheet 17 of 21
File:		

SE Electronics BV

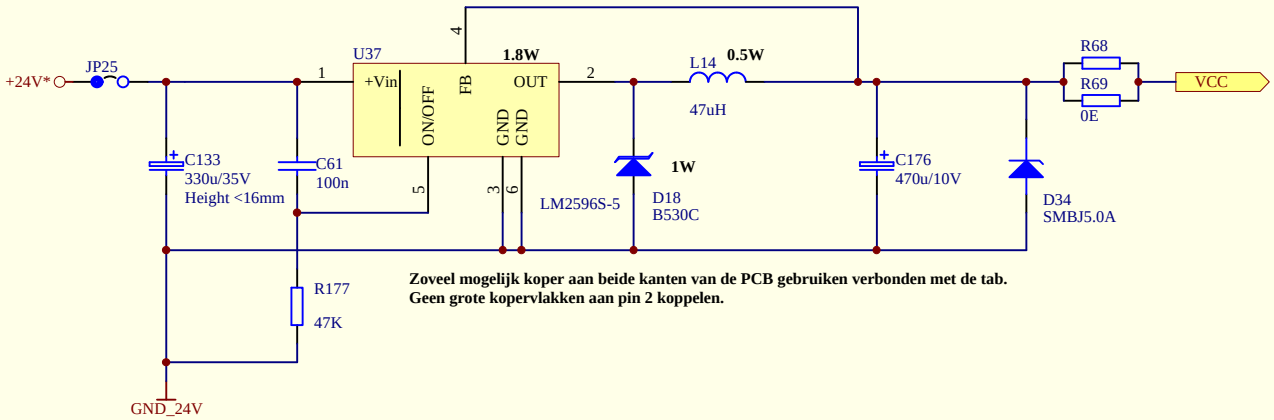
Koper opp. ca. 6 vierkante cm.



Title: *24V/-20V Inverter & 12V supply*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:55:13	Sheet 18 of 21
File:		

SE Electronics BV

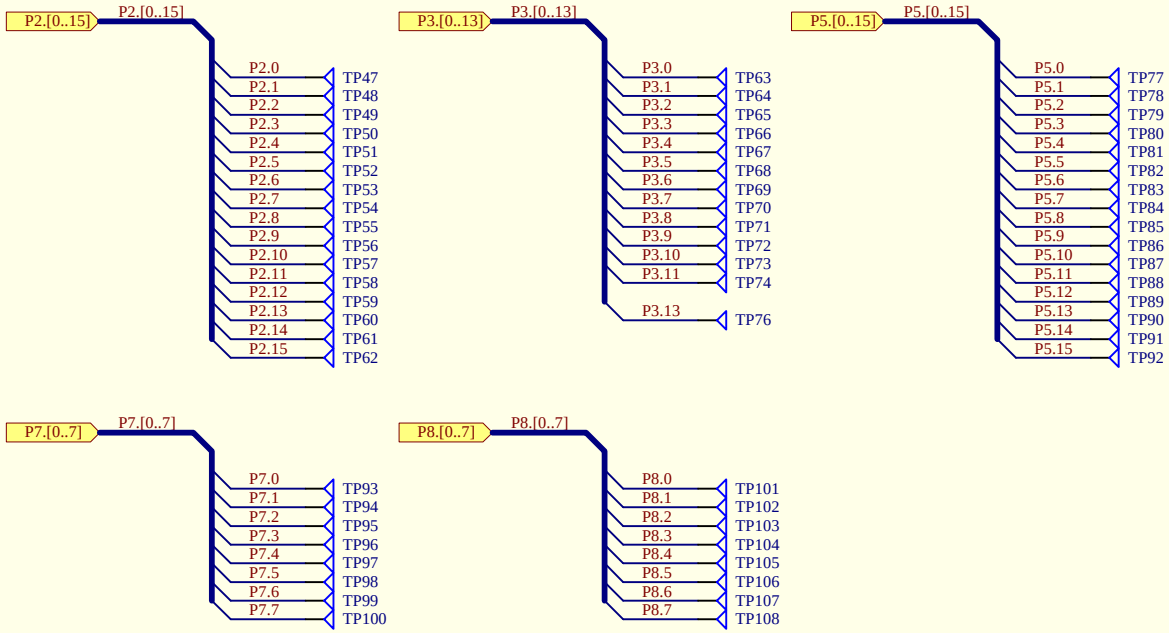
Koper opp. ca. 6 vierkante cm.



Zoveel mogelijk koper aan beide kanten van de PCB gebruiken verbonden met de tab.
Geen grote kopervlakken aan pin 2 koppelen.

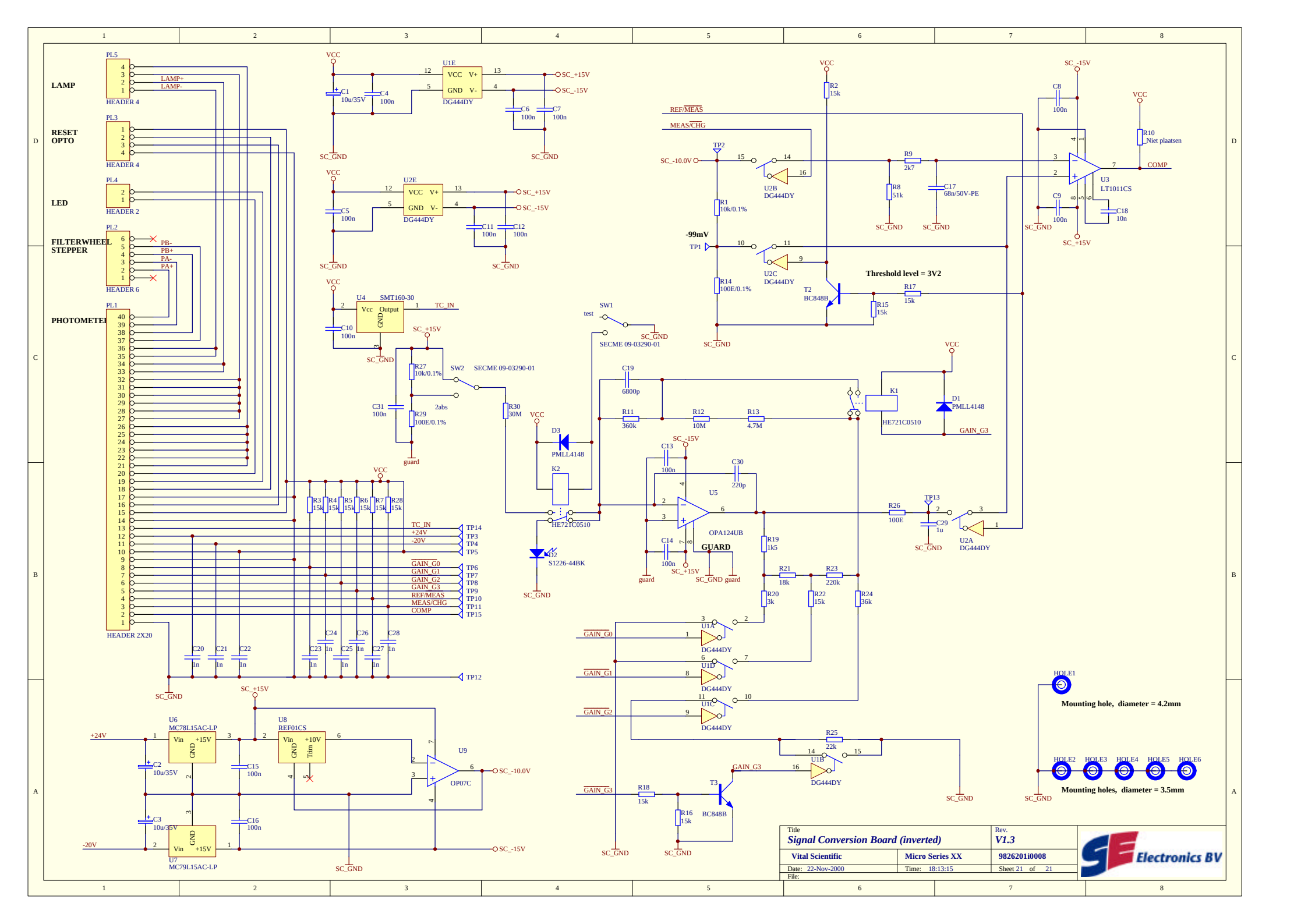
Title: ***Internal printer Power Supply***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:55:14	Sheet 19 of 21
File:		

SE Electronics BV



Title		Rev.
Test points		***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:55:15	Sheet 20 of 21
File:		

SE Electronics BV


LAMP
RESET OPTO
LED
FILTERWHEEL STEPPER
PHOTOMETER
PL5
PL3
PL4
PL2
PL1
HEADER 4
HEADER 4
HEADER 2
HEADER 6
HEADER 2X20
LAMP+
LAMP-
PB-
PB+
PA-
PA+
U1E
DG444DY
U2E
DG444DY
U4 SMT160-30
SW1 test
SECME 09-03290-01
SW2 SECME 09-03290-01
U2B DG444DY
U2C DG444DY
U2A DG444DY
U1A DG444DY
U1D DG444DY
U1C DG444DY
U1B DG444DY
U3 LT1011CS
U5 OPA124UB
U6 MC78L15AC-LP
U7 MC79L15AC-LP
U8 REF01CS
U9 OP07C
K1 HE721C0510
K2 HE721C0510
D1 PMLL4148
D2 S1226-44BK
D3 PMLL4148
T2 BC848B
T3 BC848B
Threshold level = 3V2
-99mV
GUARD
REF/MEAS
MEAS/CHG
COMP
GAIN_G0
GAIN_G1
GAIN_G2
GAIN_G3
TC_IN
+24V
-20V
Mounting hole, diameter = 4.2mm
Mounting holes, diameter = 3.5mm
Title
Signal Conversion Board (inverted)
Rev.
V1.3
Vital Scientific
Micro Series XX
98262011i0008
Date: 22-Nov-2000
Time: 18:13:15
Sheet 21 of 21
File:
Electronics BV

A.4.1 Functional electronics diagram

The following drawing offers the service technician an overview of the electronics functions of the Micro Series.

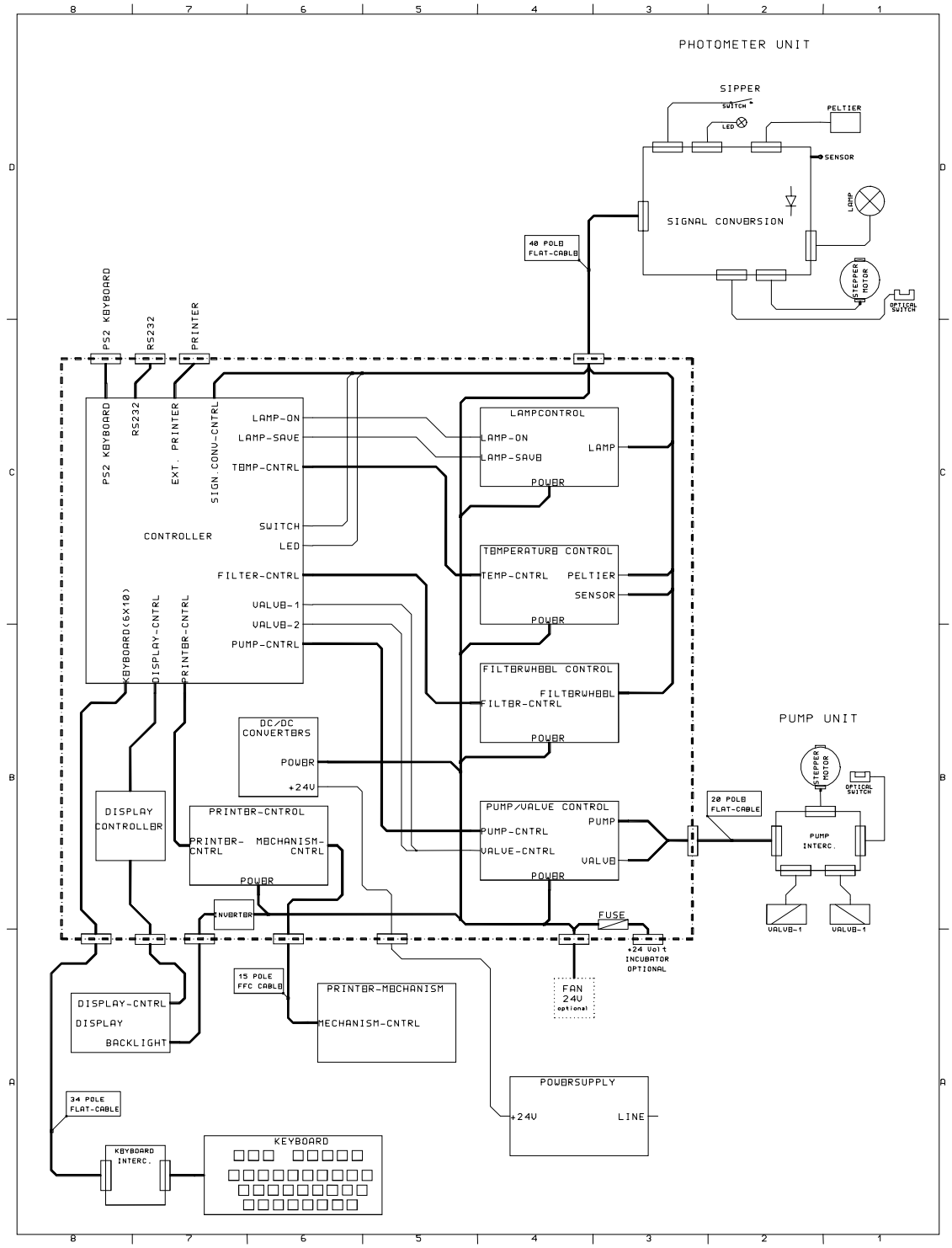
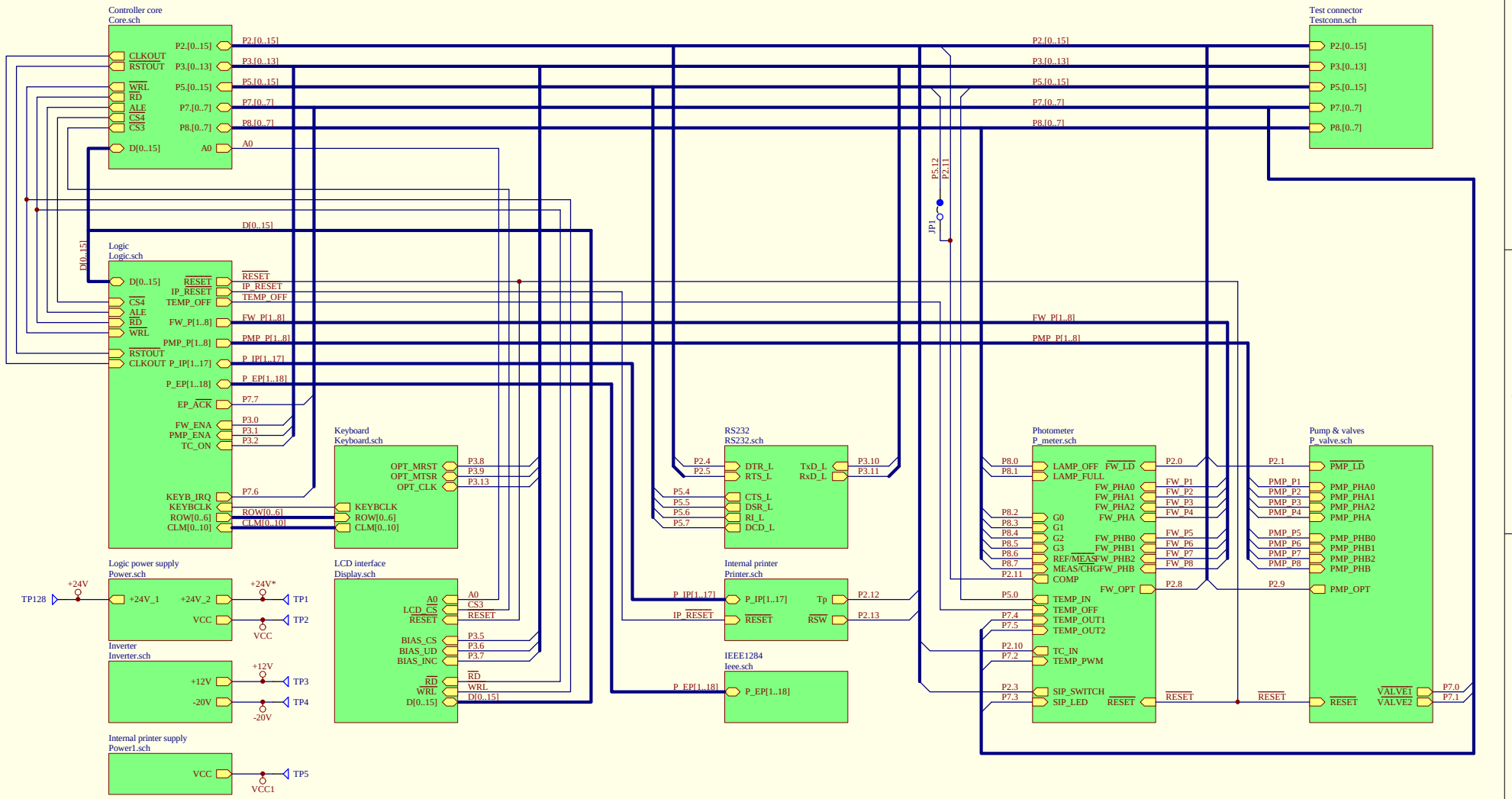


Figure 9: Functional electronics

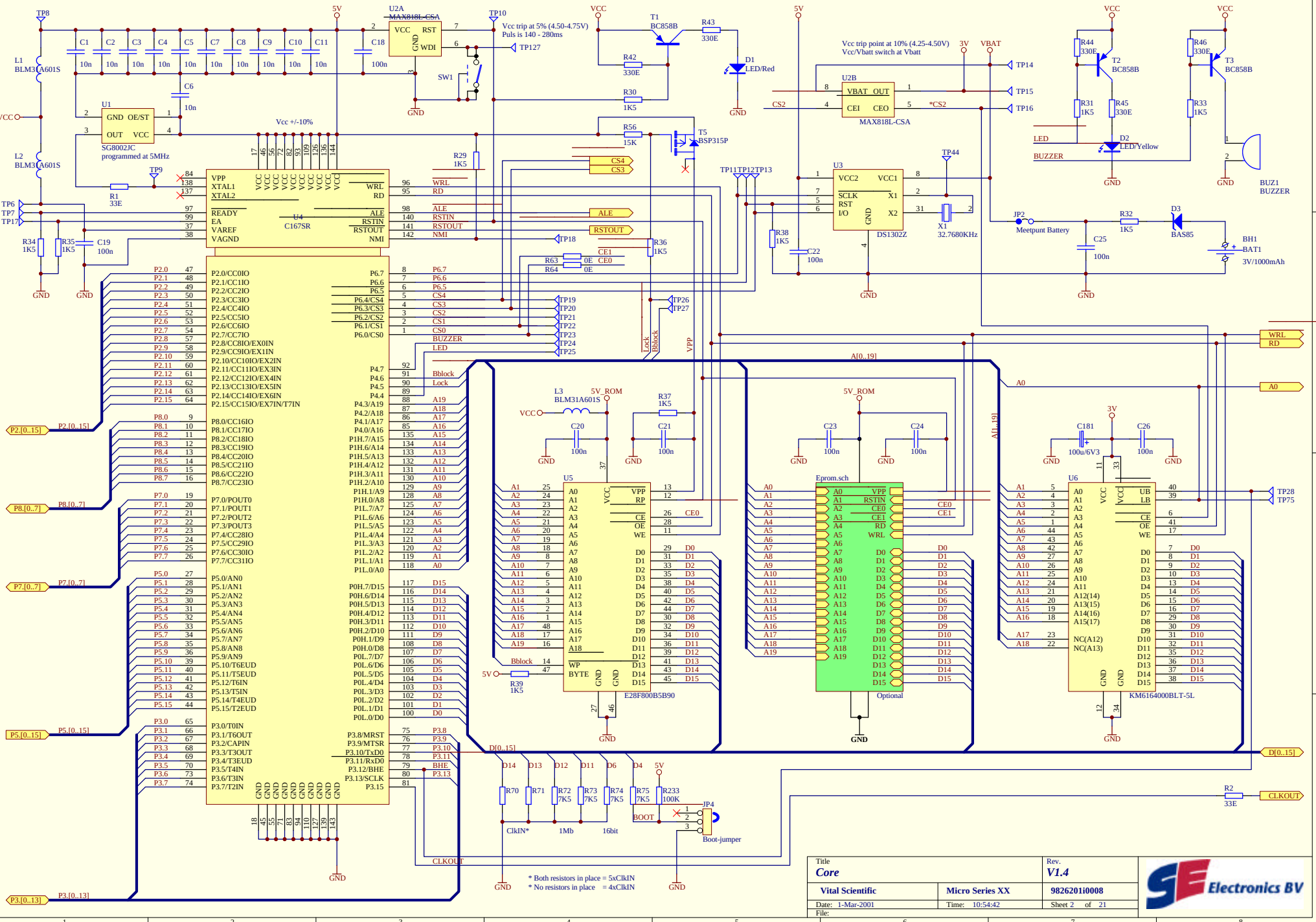
VITAL SCIENTIFIC N.V.

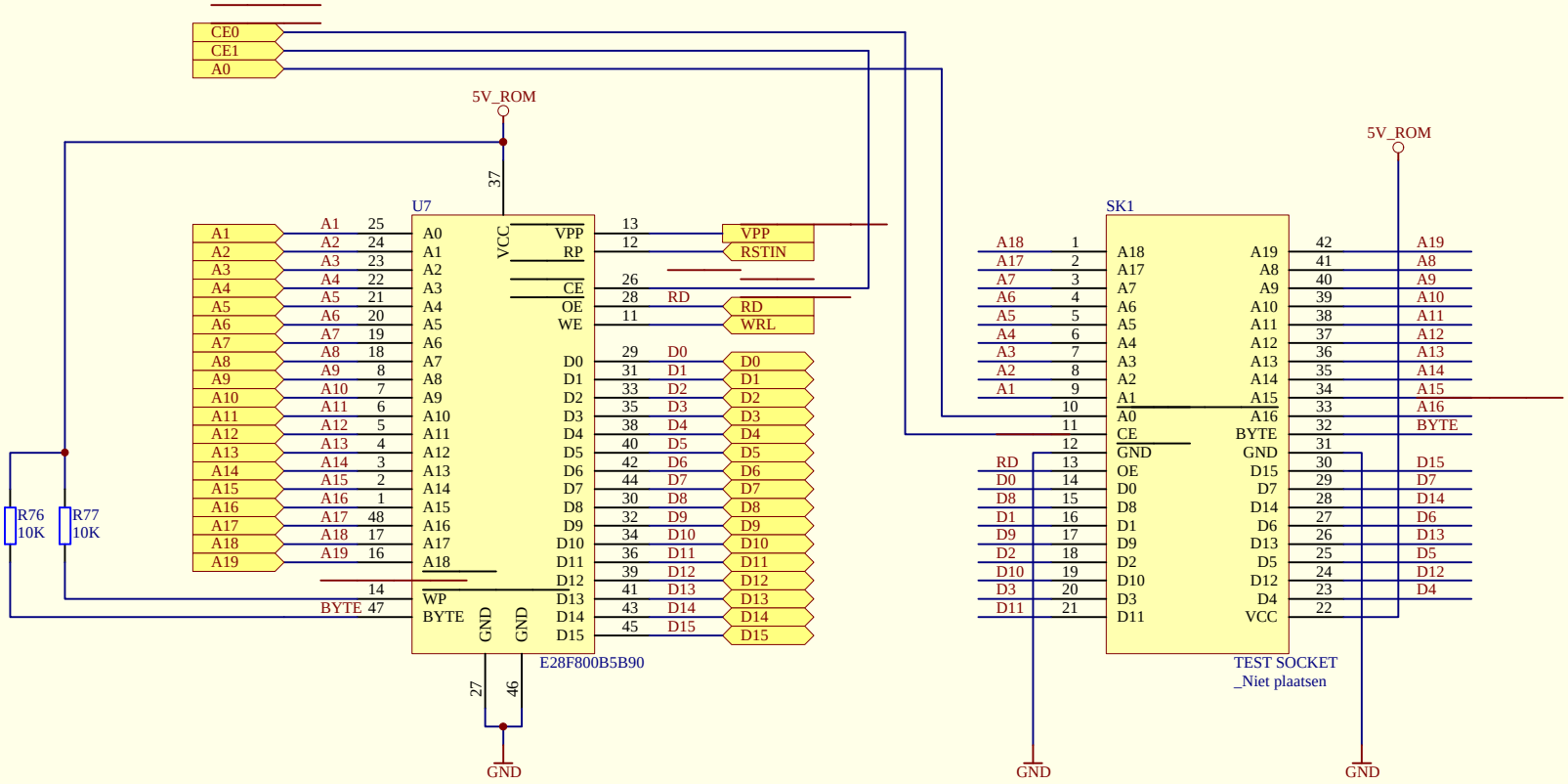


Mounting holes GND **Fiducials**

Title: ***Main board***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**98262011i0008**
Date: 1-Mar-2001	Time: 10:54:34	Sheet 1 of 21
File:		

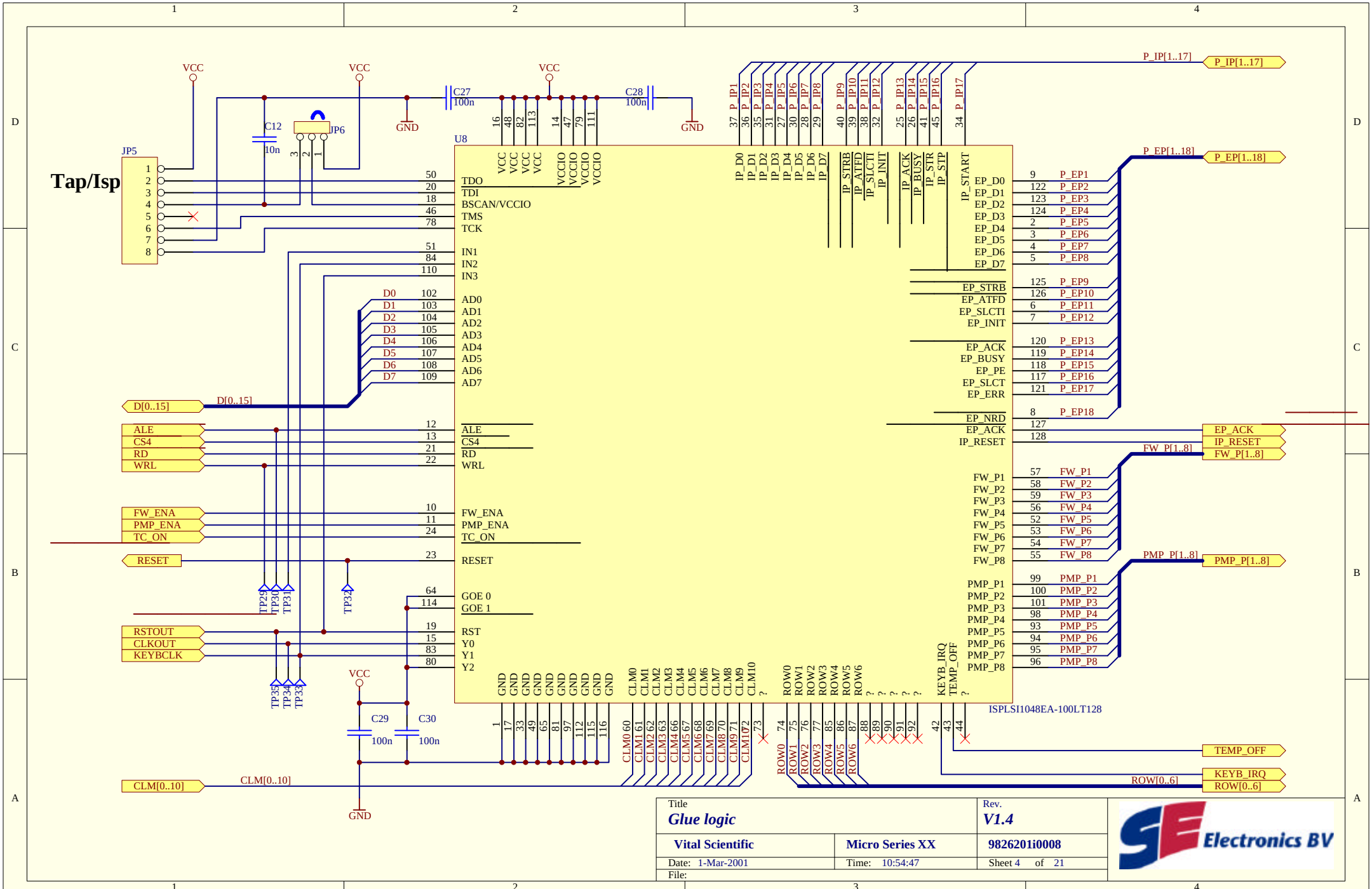
Electronics BV


U2A
MAX818L-CSA
Vcc trip at 5% (4.50-4.75V)
Puls is 140 - 280ms
Vcc trip point at 10% (4.25-4.50V)
Vcc/Vbatt switch at Vbatt
MAX818L-CSA
SG8002JC
programmed at 5MHz
C167SR
DS1302Z
32.7680KHz
Meetpunt Battery
3V/1000mAh
BUZ1
BUZZER
E28F800B5B90
KM6164000BLT-5L
Eprom.sch
Optional
Boot-jumper
* Both resistors in place = 5xClkIN
* No resistors in place = 4xClkIN
Title
Core
Rev.
V1.4
Vital Scientific
Micro Series XX
98262011i0008
Date: 1-Mar-2001
Time: 10:54:42
Sheet 2 of 21
File:
Electronics BV



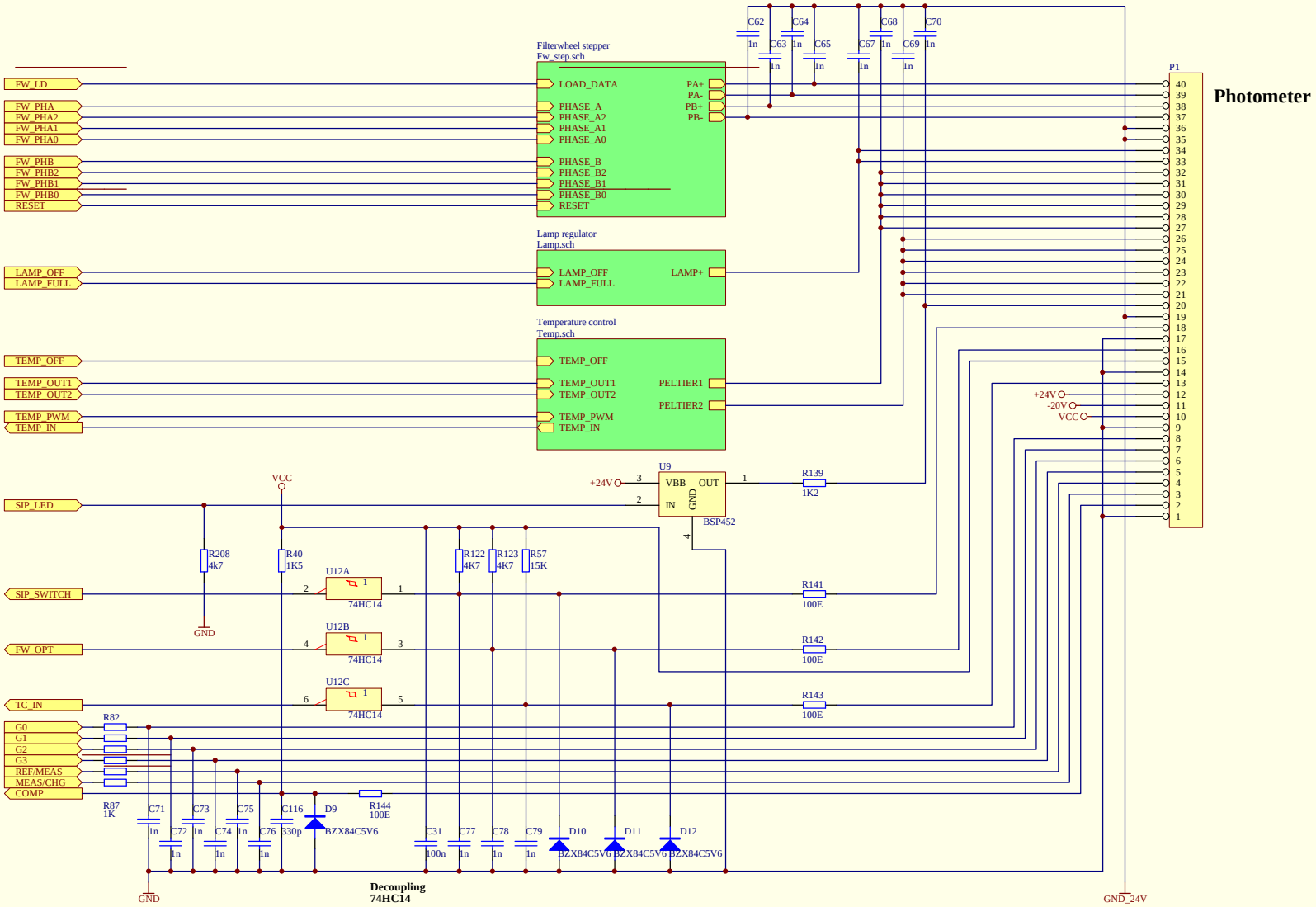
Title: ***Optional FlashROM & Test connector***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:43	Sheet 3 of 21
File:		

SE Electronics BV



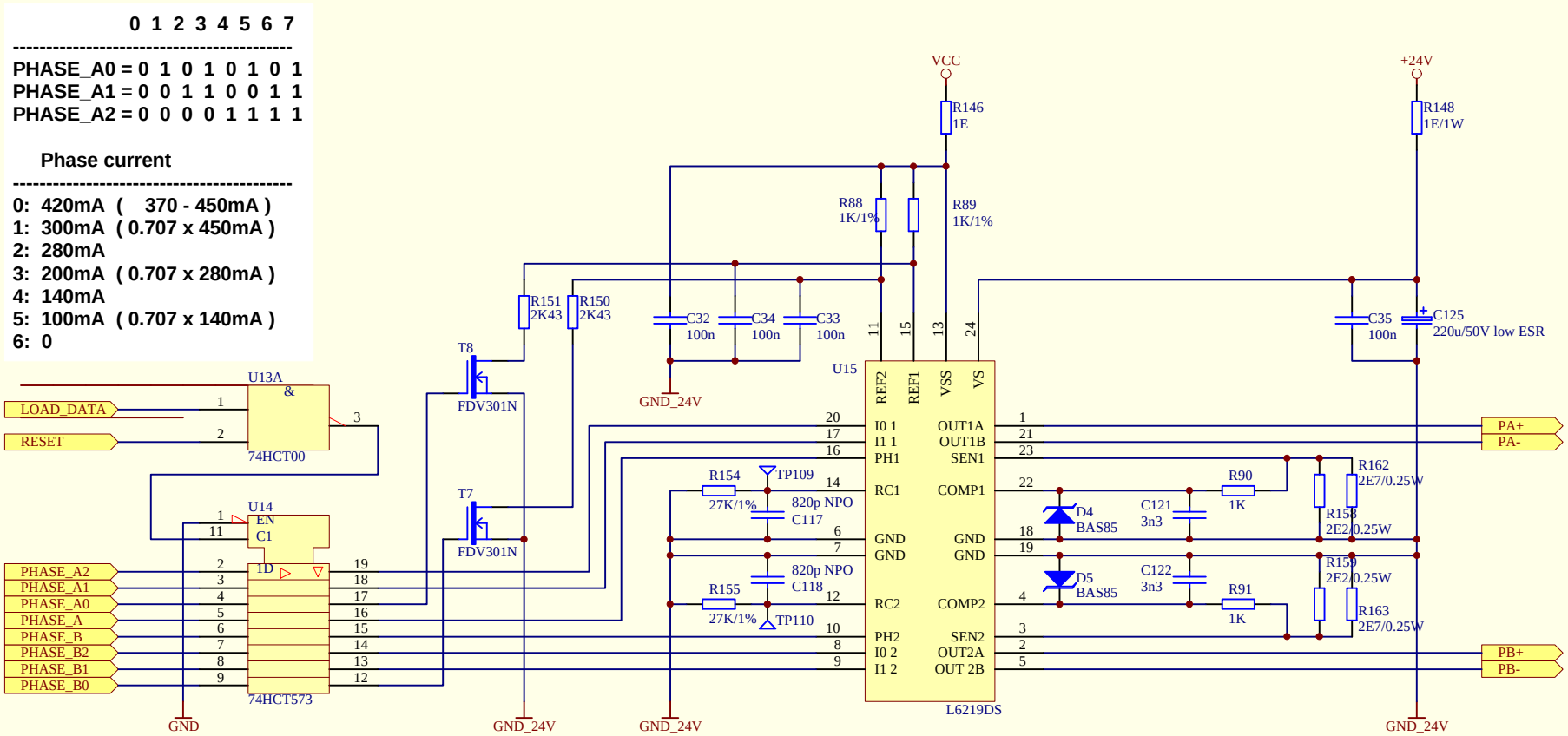
Title: *Glue logic*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:47	Sheet 4 of 21
File:		

SE Electronics BV



Title: ***Photo Meter Unit***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**98262011i0008**
Date: 1-Mar-2001	Time: 10:54:48	Sheet 5 of 21
File:		

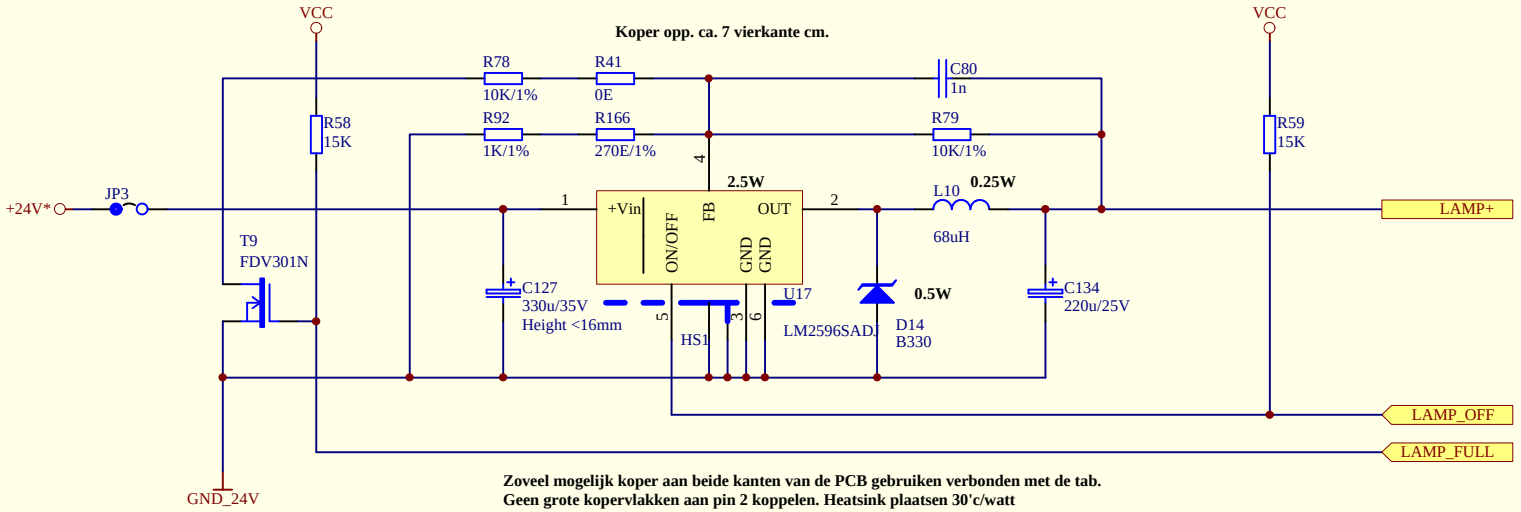
SE Electronics BV



Zoveel mogelijk koper aan beide kanten van de PCB gebruiken verbonden met alle GND pinnen.

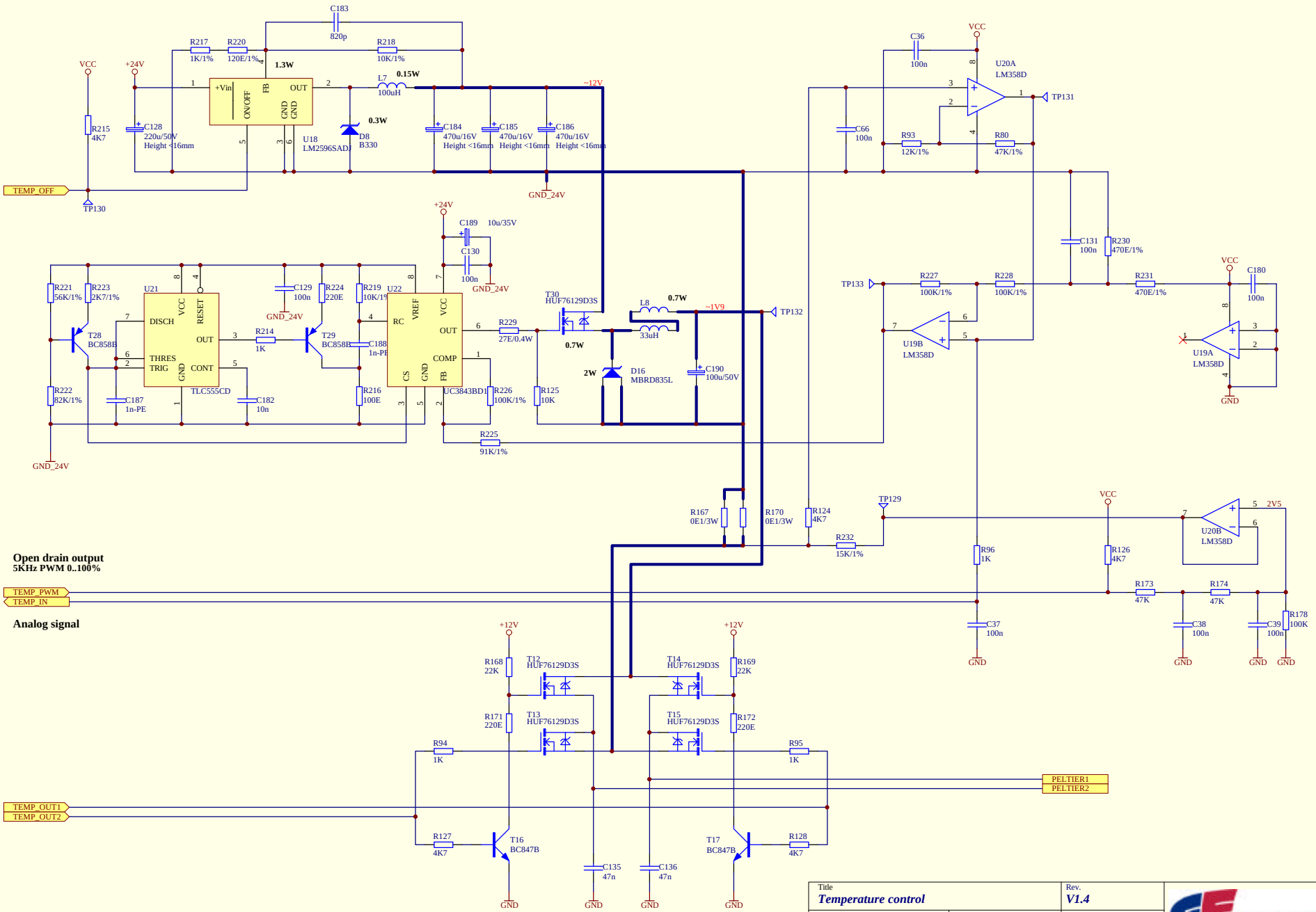
Title: ***Filterwheel stepper driver***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:51	Sheet 6 of 21
File:		

SE Electronics BV



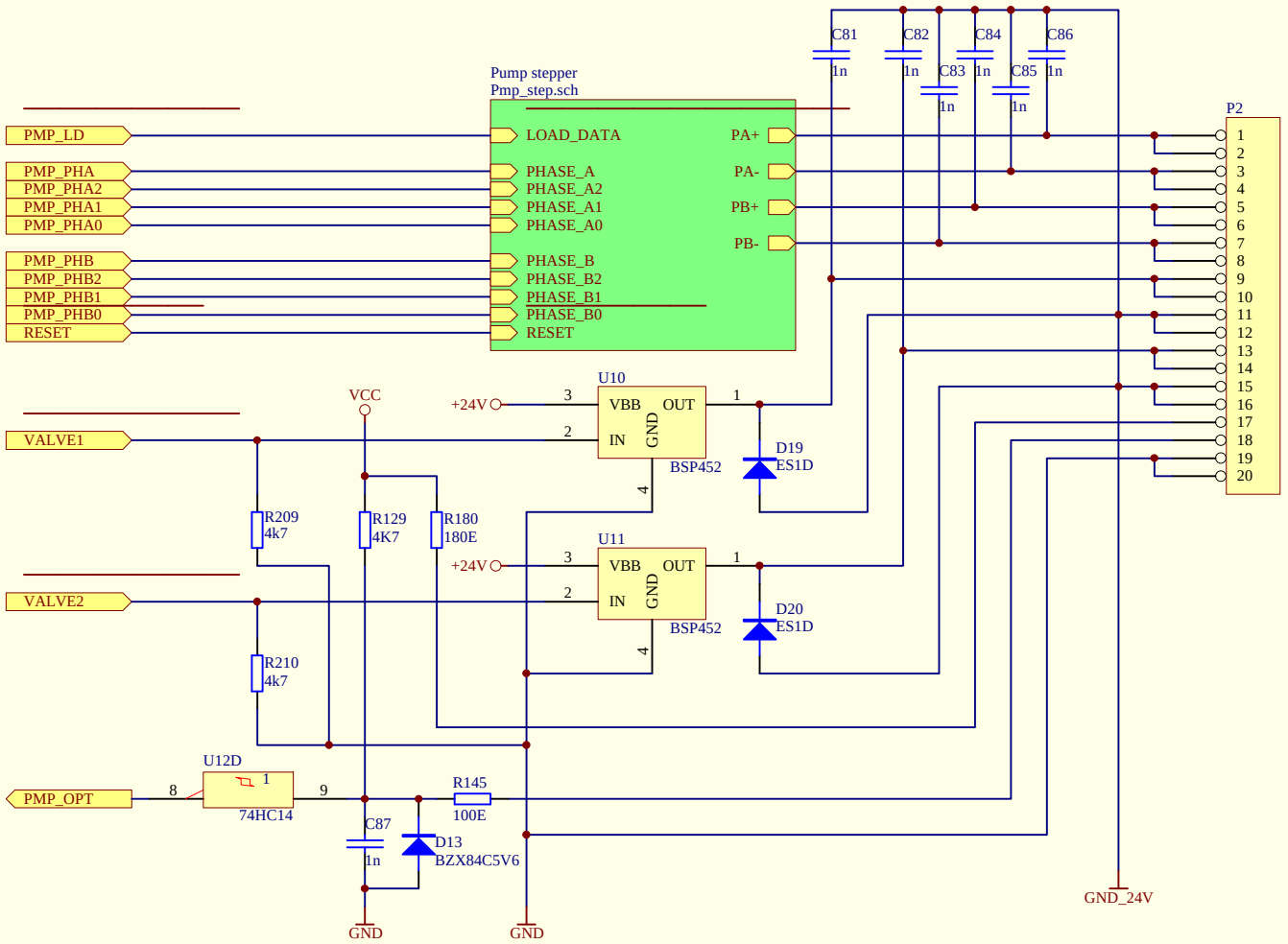
Title: *LAMP Regulator*		Rev.: *V1.4*
Vital Scientific	Micro Series XX	9826201i0008
Date: 1-Mar-2001	Time: 10:54:52	Sheet 7 of 21
File:		

SE Electronics BV



Title: *Temperature control*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**98262011i0008**
Date: 1-Mar-2001	Time: 10:54:53	Sheet 8 of 21
File:		

SE Electronics BV



Pump / Valve Interconnection

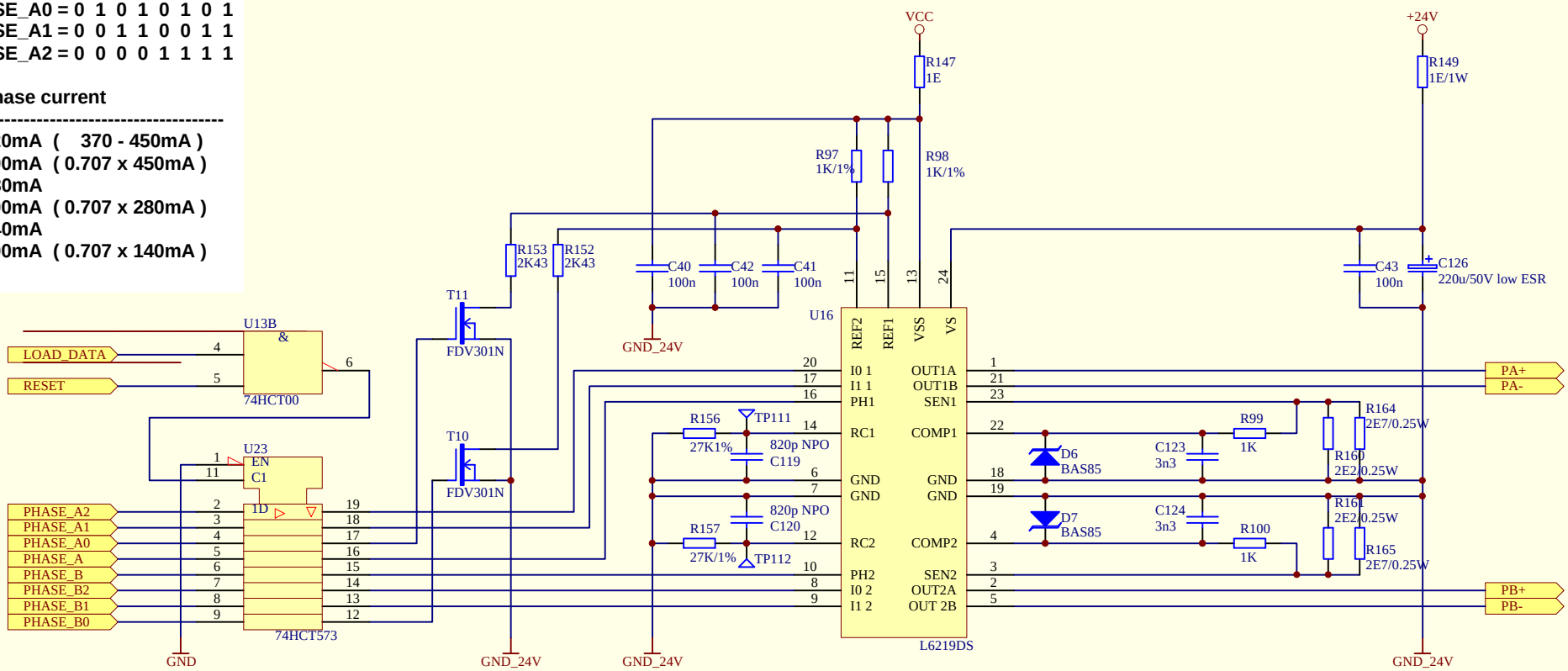
Title: ***Pump and valve control***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:56	Sheet 9 of 21
File:		

SE Electronics BV

	0	1	2	3	4	5	6	7
PHASE_A0 =	0	1	0	1	0	1	0	1
PHASE_A1 =	0	0	1	1	0	0	1	1
PHASE_A2 =	0	0	0	0	1	1	1	1

Phase current

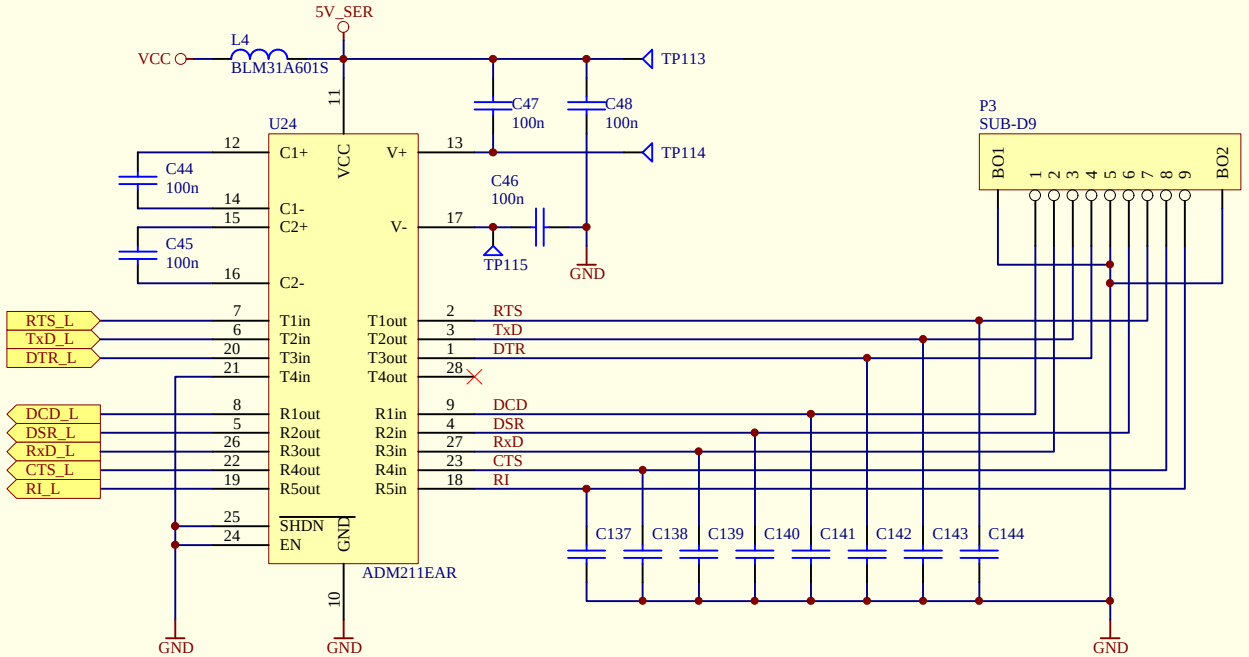
0: 420mA (370 - 450mA)
1: 300mA (0.707 x 450mA)
2: 280mA
3: 200mA (0.707 x 280mA)
4: 140mA
5: 100mA (0.707 x 140mA)
6: 0



Zoveel mogelijk koper aan beide kanten van de PCB gebruiken verbonden met alle GND pinnen.

Title: ***Pump stepper driver***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:58	Sheet 10 of 21
File:		

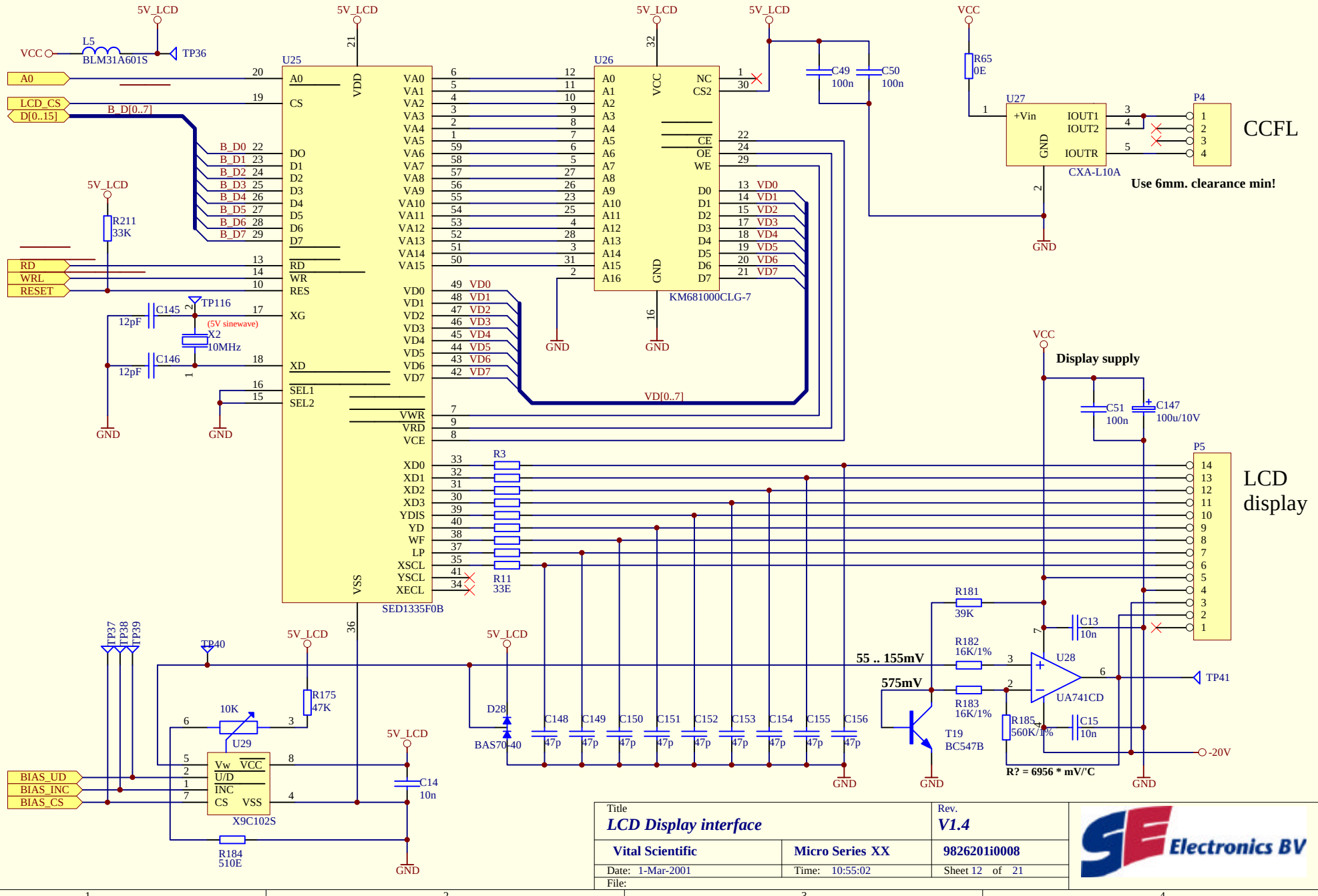
SE Electronics BV



DTE, RS232

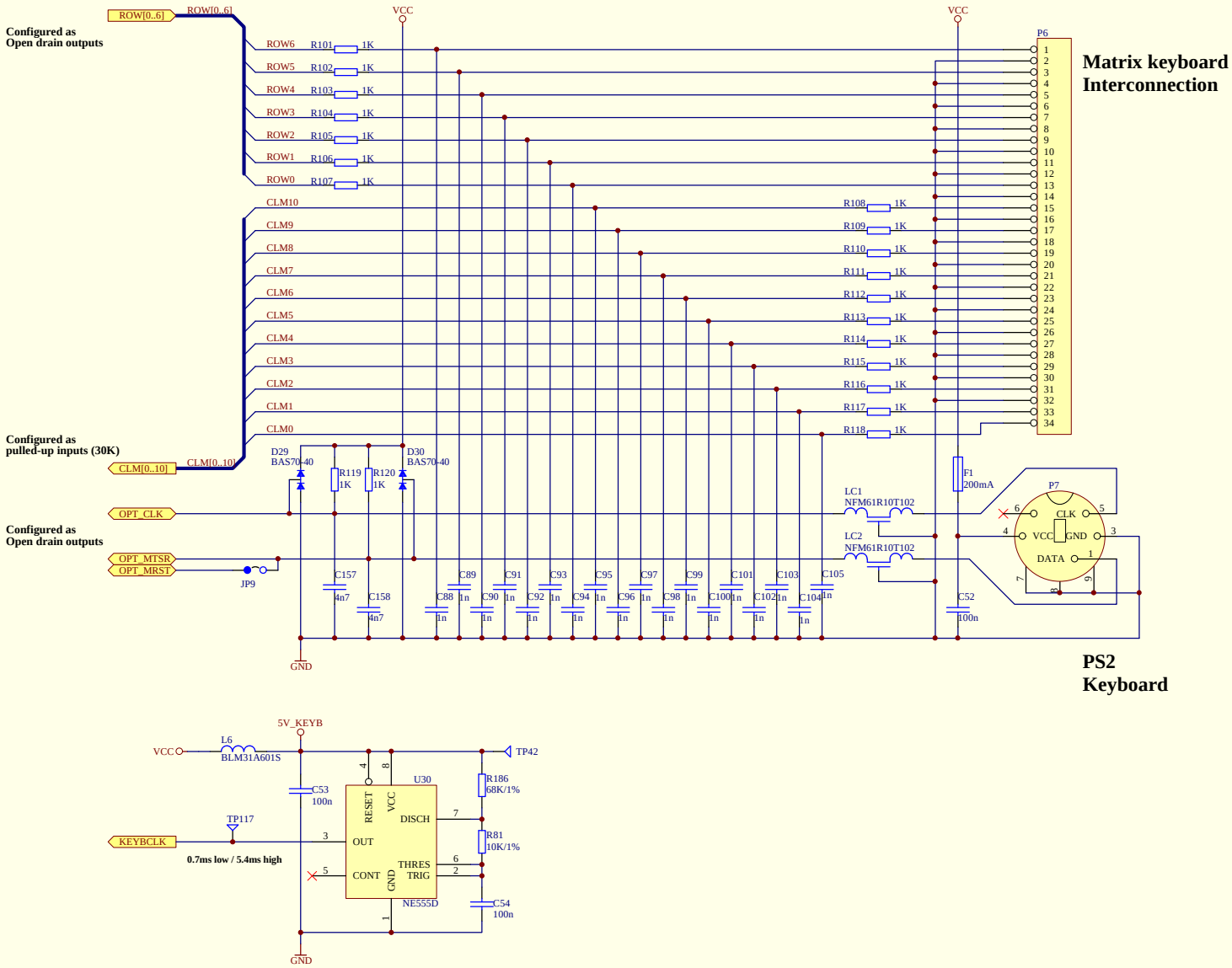
Title: ***RS232 Interface***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:54:59	Sheet 11 of 21
File:		

SE Electronics BV



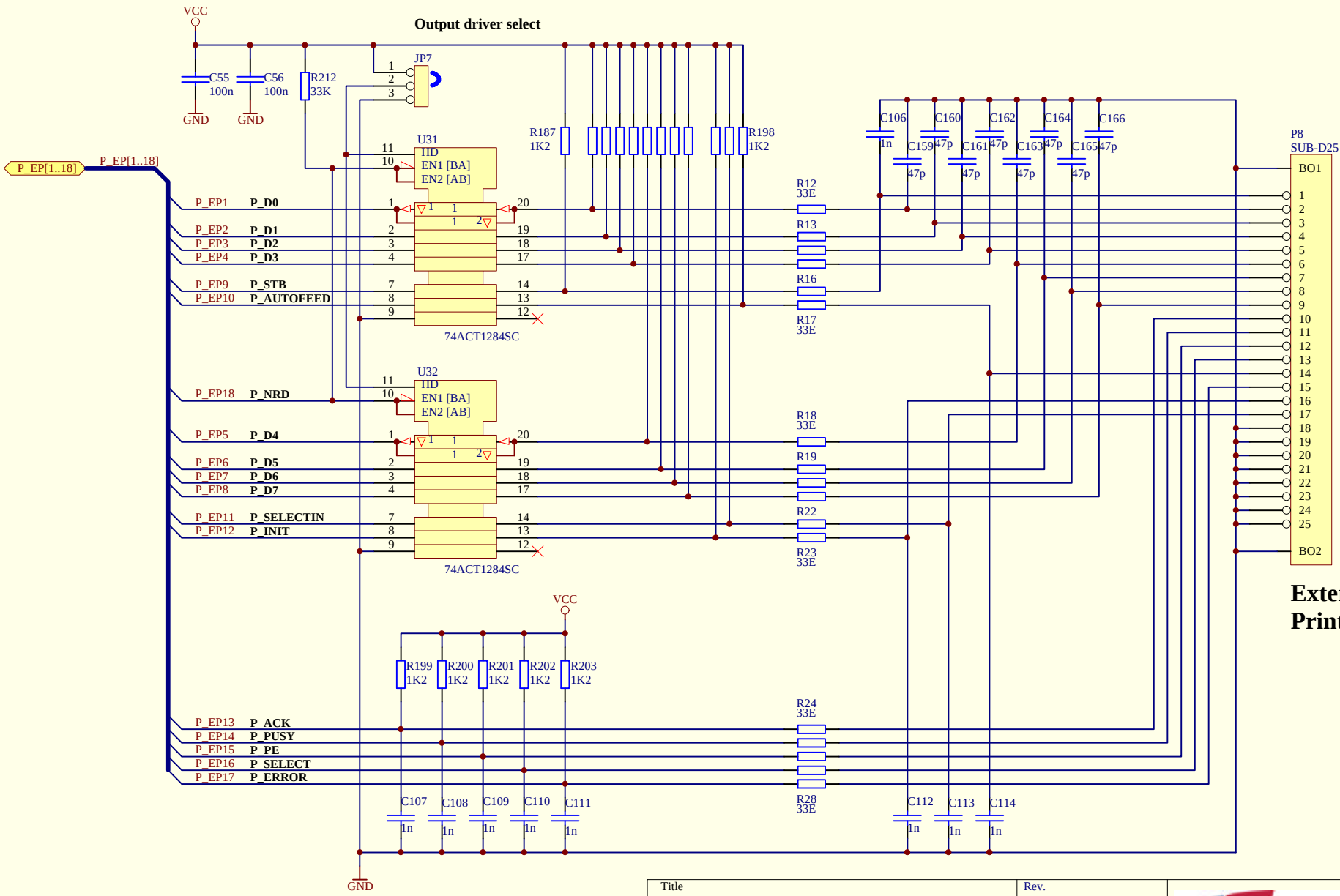
Title: *LCD Display interface*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:55:02	Sheet 12 of 21
File:		

Electronics BV



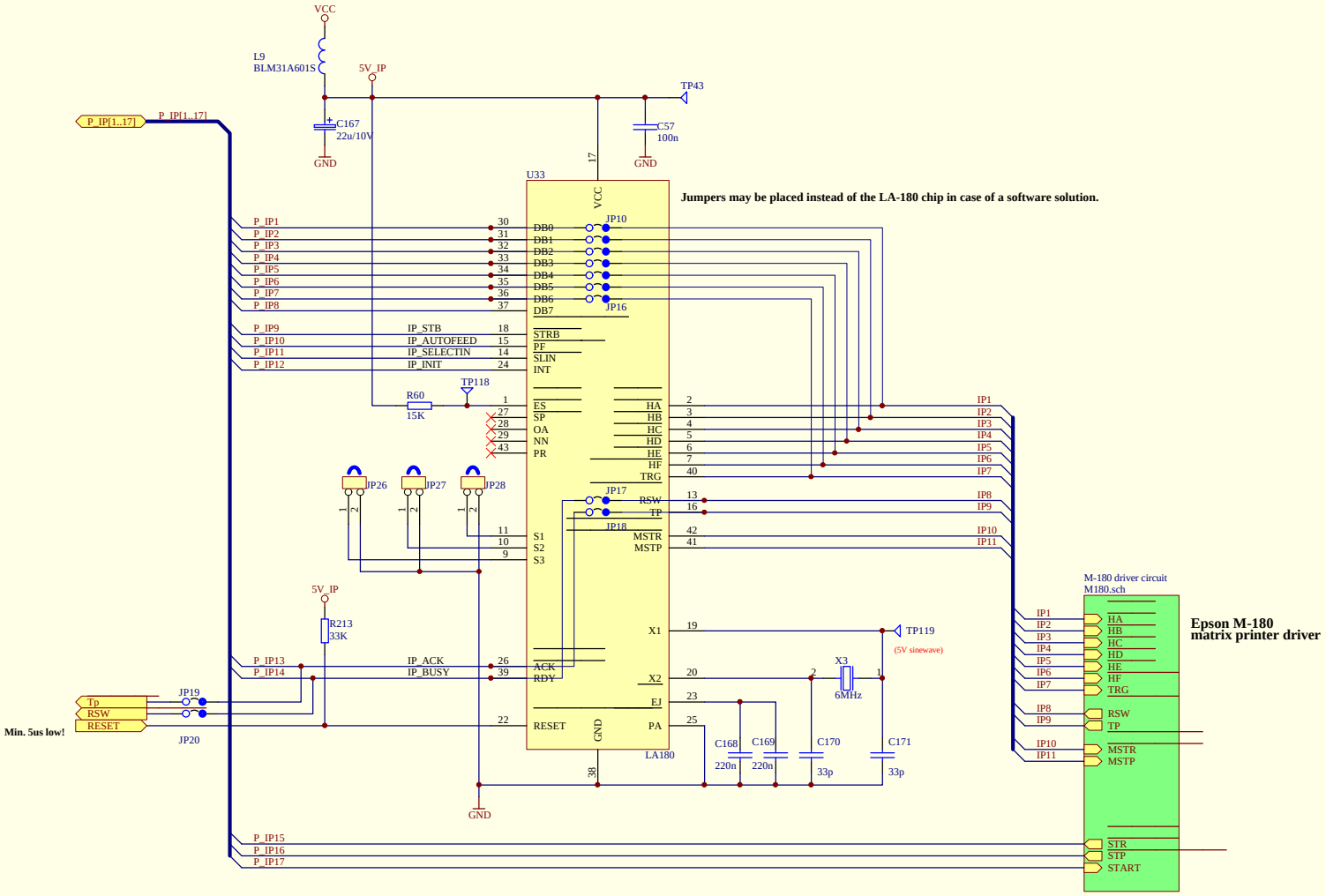
Title: *Keyboard interface*		Rev.: *V1.4*
Vital Scientific	Micro Series XX	98262011i0008
Date: 1-Mar-2001	Time: 10:55:03	Sheet 13 of 21
File:		

Electronics BV



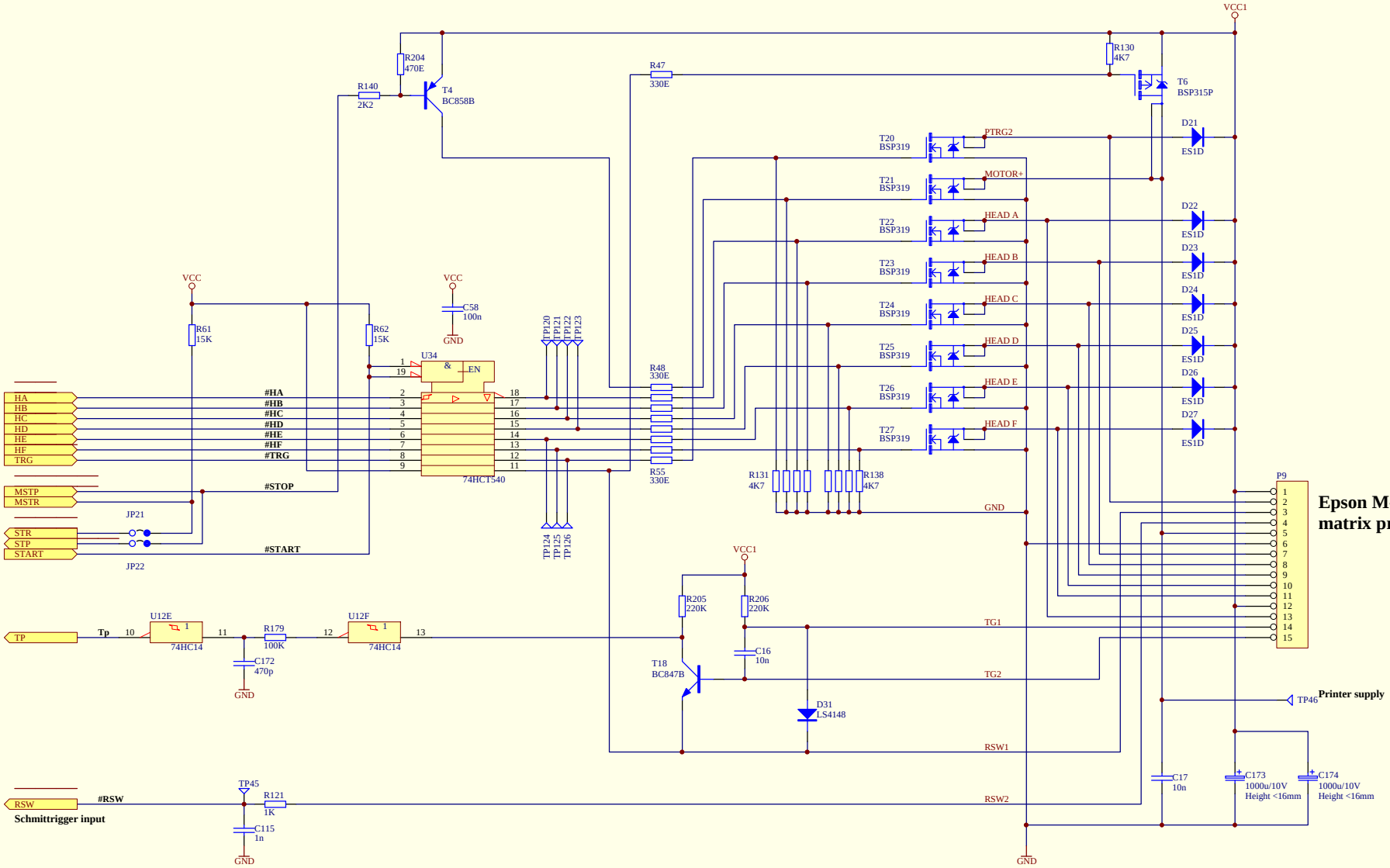
Title: *External printer interface*		Rev.: *V1.4*
Vital Scientific	Micro Series XX	9826201i0008
Date: 1-Mar-2001	Time: 10:55:06	Sheet 14 of 21
File:		

SE Electronics BV



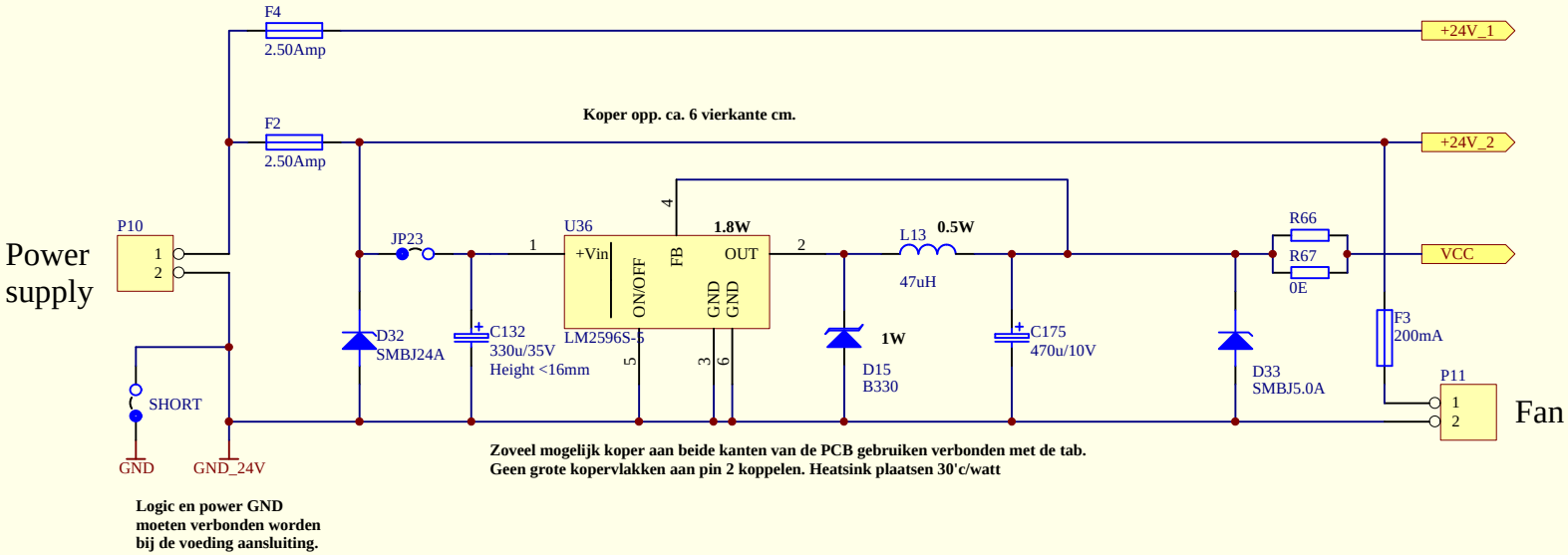
Title: *Internal printer interface, controller*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**98262101i0008**
Date: 1-Mar-2001	Time: 10:55:08	Sheet 15 of 21
File:		

Electronics BV



Title: *Internal printer interface, driver*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**98262101i0008**
Date: 1-Mar-2001	Time: 10:55:10	Sheet 16 of 21
File:		

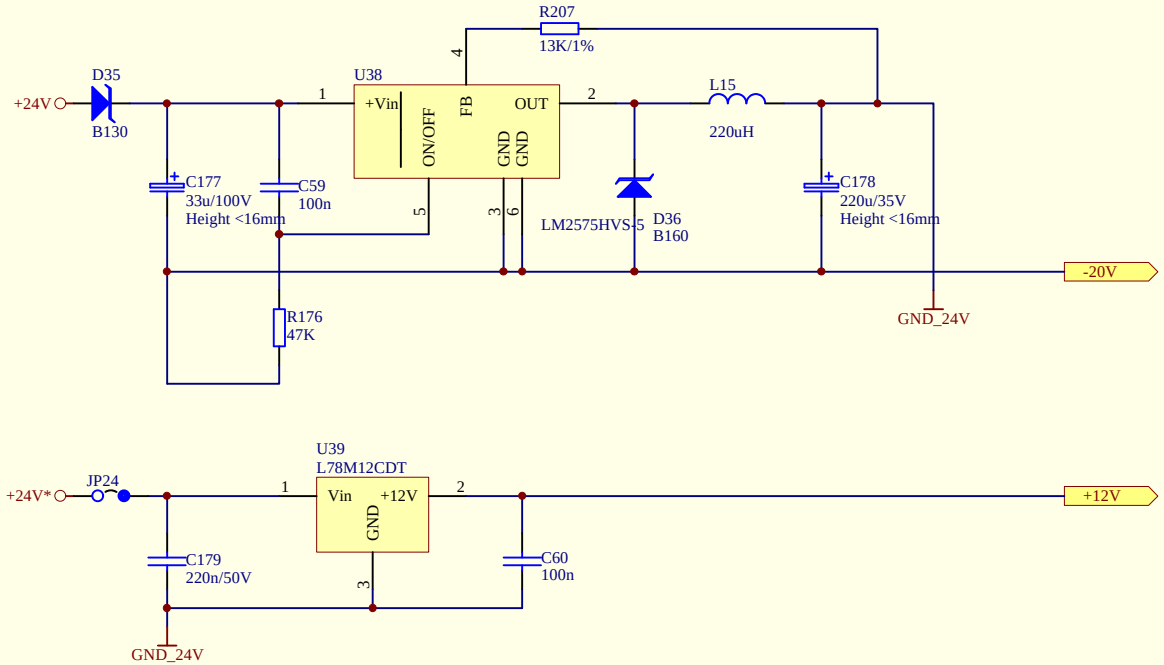
SE Electronics BV



Title: *Logic Power Supply*		Rev.: *V1.4*
Vital Scientific	Micro Series XX	9826201i0008
Date: 1-Mar-2001	Time: 10:55:12	Sheet 17 of 21
File:		

SE Electronics BV

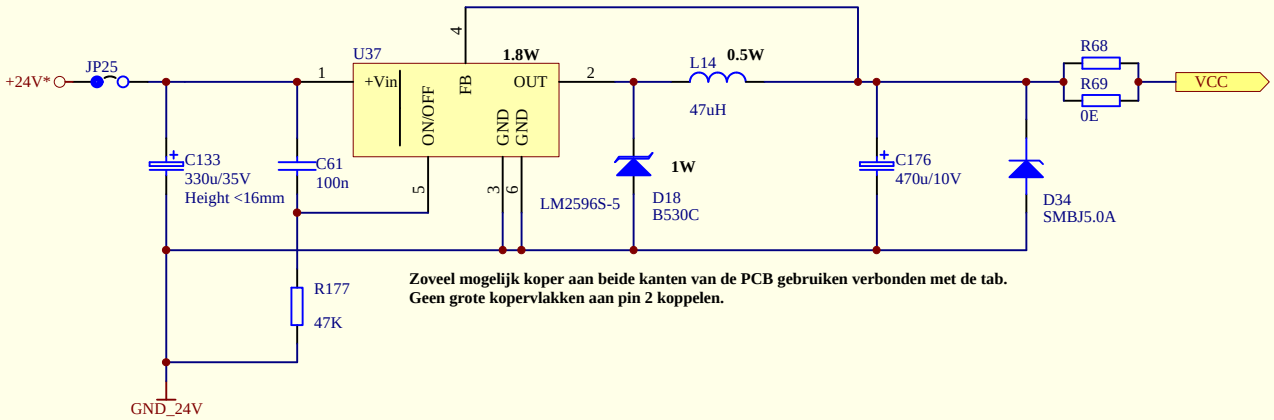
Koper opp. ca. 6 vierkante cm.



Title: *24V/-20V Inverter & 12V supply*		Rev.: *V1.4*
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:55:13	Sheet 18 of 21
File:		

SE Electronics BV

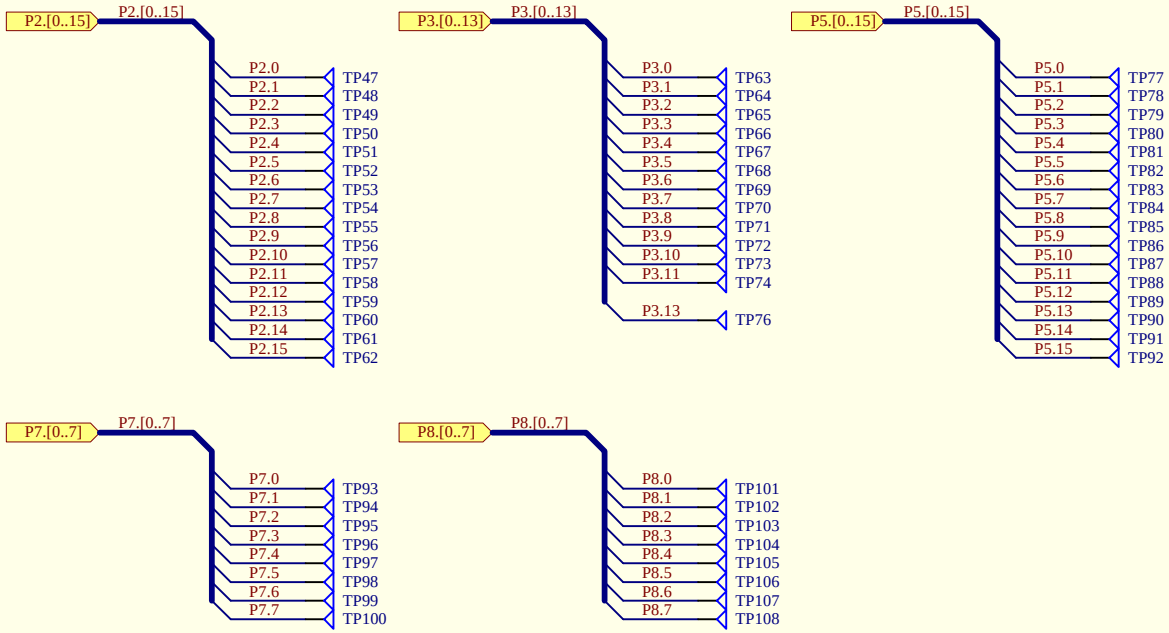
Koper opp. ca. 6 vierkante cm.



Zoveel mogelijk koper aan beide kanten van de PCB gebruiken verbonden met de tab.
Geen grote kopervlakken aan pin 2 koppelen.

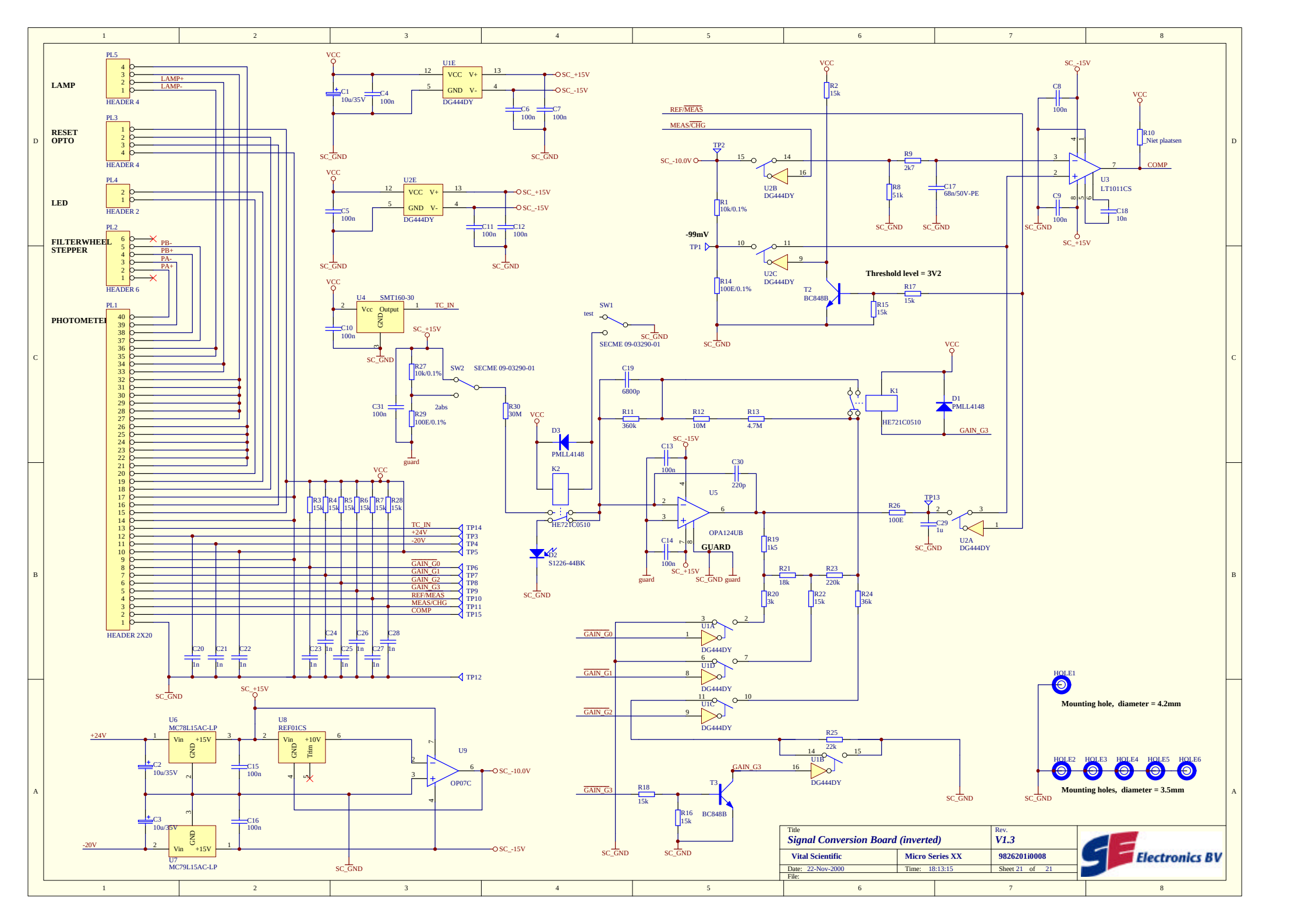
Title: ***Internal printer Power Supply***		Rev.: ***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:55:14	Sheet 19 of 21
File:		

SE Electronics BV



Title		Rev.
Test points		***V1.4***
Vital Scientific	**Micro Series XX**	**9826201i0008**
Date: 1-Mar-2001	Time: 10:55:15	Sheet 20 of 21
File:		

SE Electronics BV


LAMP
RESET OPTO
LED
FILTERWHEEL STEPPER
PHOTOMETER
PL5
PL3
PL4
PL2
PL1
HEADER 4
HEADER 4
HEADER 2
HEADER 6
HEADER 2X20
LAMP+
LAMP-
PB-
PB+
PA-
PA+
U1E
DG444DY
U2E
DG444DY
U4 SMT160-30
SW1 test
SECME 09-03290-01
SW2 SECME 09-03290-01
U2B DG444DY
U2C DG444DY
U2A DG444DY
U1A DG444DY
U1D DG444DY
U1C DG444DY
U1B DG444DY
U3 LT1011CS
U5 OPA124UB
U6 MC78L15AC-LP
U7 MC79L15AC-LP
U8 REF01CS
U9 OP07C
K1 HE721C0510
K2 HE721C0510
D1 PMLL4148
D2 S1226-44BK
D3 PMLL4148
T2 BC848B
T3 BC848B
Threshold level = 3V2
-99mV
GUARD
REF/MEAS
MEAS/CHG
COMP
GAIN_G0
GAIN_G1
GAIN_G2
GAIN_G3
TC_IN
+24V
-20V
Mounting hole, diameter = 4.2mm
Mounting holes, diameter = 3.5mm
Title
Signal Conversion Board (inverted)
Rev.
V1.3
Vital Scientific
Micro Series XX
98262011i0008
Date: 22-Nov-2000
Time: 18:13:15
Sheet 21 of 21
File:
Electronics BV

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1. Safety Precautions and Potential Hazards

1 Safety Precautions and Potential Hazards

1.1 General

Before you start installing and working with the analyser, you should read the safety precautions and regulations detailed in this chapter. Safety comes first!

1.2 Operator Qualifications

- Operation should be conducted under the management of a technician who has undergone training at the facility specified by the sales agent.
- For clinical tests, the instrument should be used under the management of a doctor or clinical inspector.

1.3 Service Technician Qualifications

To install, maintain and repair the instrument, a service technician has to be trained in the use of the instrument by the manufacturer or their representative. A service technician is also expected to be familiar with the normal operation of the instrument as described in the User's Manual and the special operations as described in the Service Manual.

1.4 Description of Symbols

Symbols on the instrument

This symbol means that the labelled item is hot while the instrument is in use. Do not touch the labelled item as you could be burnt!

This means that the labelled item could lead to personal injury and/or damage to the analyser.

Note

Notes contain additional information corresponding to the text.

1.5 Electrical

Please pay attention to the following items:

- To prevent the risk of electrical shock and/or damage to the instrument **Operators** should not open the top cover of the instrument. Only authorised personnel, for example, **service technicians,** may open the instrument to perform maintenance or repair.
- Don't touch the main board when the power is on as this may cause severe injury or death.

1.6 Mechanical

There is no risk presented by the mechanical parts of the instrument when both the covers are closed. If the covers of the instrument are removed, mechanical parts could cause personal injury if touched or become damaged. Therefore, the following advice must be followed: DO NOT wear loose garments or jewellery that could catch in mechanisms. DO NOT put your fingers/ hands into the path of any part while the analyser is in operation. DO NOT attempt to make mechanical repairs unless the instrument is not in operation or turned OFF.

1.7 Lamp

During operation, the photometric lamp becomes extremely hot. DO NOT look directly into the light path of the lamp when it is on. **DO NOT touch the lamp when it is on!**

If the lamp needs to be changed, always turn off the lamp by switching off the instrument and then wait until the lamp has cooled down.

1.8 Chemical

The operator is responsible for taking all necessary precautions against hazards associated with the use of clinical laboratory chemicals. Specific recommendations for each reagent used with the analyser are normally found on the manufacturer's package inserts or on product information sheets for each chemical. Wipe away any reagent spillage on the instrument immediately.

1 Safety Precautions and Potential Hazards

1.9 Biohazardous Materials

As with all in vitro diagnostic equipment, patient samples and serum-based quality control (QC) products that are assayed on this system, as well as all waste from the waste container, should be treated as potentially biohazardous. All materials and mechanical components associated with the sampling and waste system should be handled according to your facility's biohazard procedure. Use the personal protective equipment recommended by your facility when handling any of these components.

Detailed recommendations:

Samples

Treat all samples as potentially biohazardous and infectious. If any sample is spilt on the instrument, utilise the correct personal protective equipment (PPE-gloves, lab coat, etc.), wipe it away immediately and clean the contaminated surface with a disinfectant.

Waste Solution and Solid Wastes

- Avoid direct contact with waste solution and/or solid waste. Both should be handled as potentially biohazardous.
- Dispose of waste solution and/or solid waste according to the relevant governmental regulations.
- Consult the reagent manufacturer for information on the concentrations of heavy metals and other toxic constituents in each reagent.

Biohazardous Parts

Avoid direct contact with the sipper tubing and all parts of the sample flow path. Treat these areas as potentially biohazardous and/or infectious.

Reagents

- Avoid direct body-contact with reagents. Direct body-contact may result in irritation or damage to your skin. Refer to the manufacturer's reagent kit box and package inserts, or product information sheets for specific instructions.
- Avoid direct body-contact with cleaning solutions. Direct body-contact may result in skin irritation or damage. Refer to the manufacturers kit box and package inserts, or product information sheets for specific instructions.

1.10 Additional precautions

Flammables

Avoid using dangerous flammable material around the instrument. Fire or explosion may be caused by ignition.

Accuracy/Precision of Measured Results

- For proper use of the instrument, measure control samples and monitor the instrument during operation.
- An incorrectly measured result may lead to an error in diagnosis, thereby posing a danger to the patient.
- Treat all reagents according the manufacturer's recommendations. Refer to the reagent kit box and package inserts, or product information sheets for specific instructions.
- Make sure that the sample/reagent mixture does not contain any blood clots, dust or other insoluble contaminants. If insoluble contaminants are contained in the sample, correct measuring values may not be obtained.

Application

- The instrument is designed for clinical chemistry test analysis using water-soluble samples and reagents.
- Please note that other types of analyses may not be applicable to this instrument.

Operation and Maintenance

- During operation and maintenance of the instrument, proceed according to the instructions and do not touch any parts of the instrument other than those specified.
- Never leave a reagent/sample mixture in the flowcell for longer than necessary. Always clean the flowcell after a batch of measurements and keep the flowcell filled with distilled water when not in use.
- Ensure that both the covers are closed when the instrument is in operation.
- Avoid touching the mechanism, such as the sipper mechanism inside the instrument, while the instrument is operating. This may cause operation to stopped or damage the instrument.

Installation Requirements

Installation should only be performed by a representative of the instrument's manufacturer. The customer is responsible for providing the necessary facilities as detailed in chapter 3.11, "Technical Data", in the User's Manual or in chapter 4.2, "Technical Data" in the Service Manual.

Instrument Unused for a Long Period of Time

If the instrument is not due to be used for a long period of time, ensure that it is cleaned, and the fluid system is thoroughly flushed and drained. Please also refer to chapter 3.3, "Storage" for helpful advice on storing.

2. Introduction

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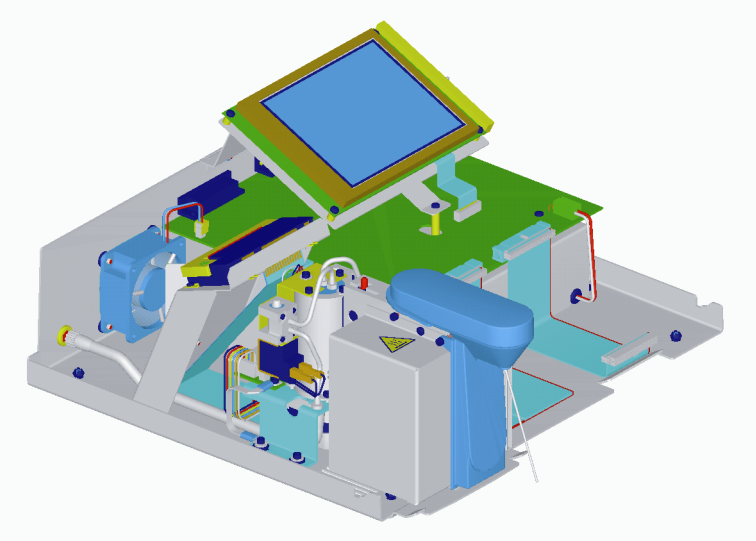
2 Introduction

2.1 System Overview



The Micro Series is a software-controlled system for clinical chemistry. It is designed for both quantitative and qualitative in vitro determinations using a wide variety of tests for the analysis of serum and plasma.

Micro Series analysers are capable of meeting all the manual or discrete requests of the clinical laboratory. The instrument has been designed with great flexibility to cater for the urgent demands of the medical as well as the laboratory staff. State of the art technology and advanced user-friendly software meet the individual requirements of each clinical laboratory.

The analyser is a small, compact instrument and comprises the analyser unit and the computer unit with a fully integrated screen and keyboard, which boasts most of the normal keys of a computer keyboard. Last but not least, an integrated printer prints out results and statistical information.

The instrument can be placed on a bench top; thus saving space in the laboratory environment. For easy operation, the most frequently used test parameters are pre-programmed so that the operator needs only to select the test and then immediately start the analysis. User-defined tests can be entered easily using the comfortable integrated keyboard. An external standard computer keyboard can be connected if required.

The software provides calibration and control measurements, up to 60 pre-programmed tests, user-defined tests, result statistics and reports.

Data transmission to and from the analyser is achieved through the serial port of the instrument. Furthermore, the parallel port of the instrument enables the management of data between a connected laboratory electronic data processing system (Lab-EDP).

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2.2 Using the Service Manual

This manual offers a detailed description of the Micro Series. It provides instructions on preventative and corrective maintenance and troubleshooting measures. The service level software functions are described in detail in the chapters where they are appropriate.

The manual is divided into the following chapters:

Chapter 1 contains the safety precautions and offers information about potential hazards.

Chapter 2 contains general information on manual structure, and information concerning repair policy, spare parts, technical assistance, service training as well as field service information.

Chapter 3 contains information on packaging, shipping, storage, and unpacking of the instrument as well as a list of contents. It describes the immediate physical conditions required when the instrument is unpacked.

Chapter 4 contains guidelines for installing the instrument and information concerning passwords for both user and service levels as well as technical data.

Chapter 5 contains a physical description of the system: for example, mechanical design of assembly groups, fluid and optical systems as well as a description of function.

Chapter 6 contains a description of the instrument component groups such as the processor board, temperature control, opto board and keyboard.

Chapter 7 contains preventative and corrective maintenance procedures for both the user and the service technician.

Chapter 8 contains information on test and diagnostic procedures included in the service level of the software.

Chapter 9 is devoted to troubleshooting procedures.

Chapter 10 contains drawings of assembly groups and individual part numbers.

Appendix The appendix is divided in to three parts where you can find additional information such as target host communication, diagrams of routines and electrical drawings.

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2.3 Repair Policy

We have implemented a fixed repair price for some parts of the instruments. These prices are based on a certain percentage of the net ex factory price of the part in question. The repair policy can be found in our sales conditions.

Vital Scientific will only accept components or component groups for repair when accompanied by a completely filled out repair form, including a clear description of the fault. This applies to claims made for components under warranty and for normal repairs. Please refer also our general sales conditions.

Repair Forms are supplied by Vital Scientific free of charge.

2.4 Spare Parts

Distributors are expected to stock sufficient spare parts to be able to provide first line service support. Vital Scientific cannot always guarantee off-the-shelf availability of spare parts due to production and other factors. A list of recommended spare parts is contained in the spare parts price list. Please refer also our general sales conditions.

2.5 Technical Assistance

Technical assistance is available if required. You may contact the service department via fax or e-mail (please refer to addresses at the front of the manual). Please have the following information available:

- a clear description of the problem
- type of instrument
- serial number of instrument
- software version.

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2.6 Service Training

Courses are organised on a regular basis with the respective information being made available in advance. Courses are generally held at Vital Scientific, but with prior consultation it is possible for these to be held at the customers site. Participants are expected to have knowledge of:

- modern analogue/digital electronics
- microprocessor technology
- basic photometric technology
- the English language.

Please contact the service department of Vital Scientific for further information concerning service training.

2.7 Field Service Information

Vital Scientific supports a field service information system, the purpose of which is to provide detailed information on the frequency and nature of failures that occur during field use. This information enables Vital Scientific to take corrective actions and to improve on design and manufacturing methods.

Two different forms are supplied with the packaging of the instrument for this purpose:

- Installation report
- Malfunction report.

We request that you return the completed forms on a regular basis (for example, once a month) by mail or fax, whichever is the more convenient for you.

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3. Shipping and Unpacking

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3 Shipping and Unpacking

3.1 General

Please ensure that the information given in this chapter is adhered to. It is designed to enable you to transport, store and unpack the instrument safely and will ensure that the instrument functions correctly once unpacked and installed.

3.2 Transport

The instrument is shipped in protective packaging that has been designed to minimise the possibility of damage during transport. The package should be properly secured during transport. The package should have no heavy weights placed on top of it, be subjected to excessive vibration or be allowed to fall.

3.3 Storage

Packaged instruments should not be stacked more than 6 high. The package should have no heavy weights placed on top of them. The place of storage must be kept dry.

The Micro Series has been designed, and tested in a climate testing chamber, to withstand temperature extremes between -20 ... +50 °C. It is recommended that the packaged instrument not be left outside where extreme conditions may quickly lead to this temperature range being exceeded.

3.4 Unpacking the Instrument

The instrument is to be unpacked and installed by trained service personnel. It is not intended that the user unpack the instrument or the accessories.

Please observe the following procedures when unpacking the instrument:

1. Remove all inserts that hold the instrument in position.
2. It must be ensured that the instrument is placed on a level surface. The surface must be clean and free from obstructions and not exposed to vibration (for example, centrifuges) or direct sunlight.

   At least 10 cm of space is required to ensure a free flow of air. At no time should the airflow of the fan located at the rear of the instrument be obstructed.

   Avoid placing close to sources of electromagnetic radiation.
3. Ensure that all contents are removed before discarding package.

Note

Please unpack the instrument with care, ensuring that no damage occurs to the sipper unit.

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3.5 Contents of Package

We strongly recommend that the contents be checked against the shipping list for completeness. You should check the package and the contents for damage. Notify the carrier and the agent immediately should you notice any damage to the packaging or contents.

Description	**Part Number**
Micro Series	6002-XX
Width x Depth x Height	40 x 36.5 x 17 (cm)
Weight	8.5 kg
Accessory kit	6002-340
Tube ∅4 x ∅8 (1 m)	1513-024
Tube ∅0.7 x ∅1.6 (0.5 m)	1503-008
Dust cover	3069-040
Paper roll	3073-025
Fuse, glass 1.6 A, slow-blow for 220 V (2 pcs.)	3348-175
Mains cable	3374-066
Halogen lamp 12 V/20 W	3380-018
Axis roll paper	4104-119
Documentation	
Flowcell cleaning procedure	3820-359
Product Data Sheet	6002-310-191
User manual (English)	6002-310-410
Declaration	6002-310-510
Certificate of quality	6002-310-513
Installation report	Please return completed installation report to Vital Scientific

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4. Installation Procedures

VITAL SCIENTIFIC N.V.

4 Installation Procedures

4.1 General

This chapter contains important technical data. It also contains guidelines for installing the instrument as well as some useful hints on how to care for the instrument.

4.2 Technical Data

Power requirements	
Line voltage	100/240 V nominal, tolerance 10%
Line frequency	50/60 Hz ± 3 Hz
Power consumption	max.100 VA
Installation category II	(in accordance with IEC 664)
Mains cable	suitable for non-polarised 220 V outlets
Environmental conditions	
Ambient temperature	15 °C - 35 °C
Maximum relative humidity	80% at temperatures up 31 °C, decreasing linear to 65% at 35 °C
Altitude	max. 2000 m
Pollution degree	2 (in accordance with IEC 664)
Approvals	CE, CB, UL

Fuses from the following companies are recommended for use in the instrument:

Manufacturer	**Type no.**	**Type**	**Current (A) (250 V)**	**A^2**	**UL approval**	**IEC 127 approval**
Schurter	SPT 0001.2506	T (HBC)	1.6	1.9	E 41599	Yes
Wickmann	19181-1.6A	T (HBC)	1.6	2.6	E 67006	Yes
Vishay	5HT-1.6A	T (HBC)	1.6	5.4	E 20624	Yes

Note

The ground connection is achieved via the net entry.

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4.3 Important Notice Concerning Requirements

Please ensure that the information given on the following pages is observed to ensure a trouble-free operation of the instrument.

4.3.1 Installation procedures

Important notes concerning installation:

- Install the analyser in such a manner ensuring that it is not exposed to (high intensity) incident light.
- Avoid extreme high or low ambient temperature and humidity.
- Never obstruct the airflow of the fan located at the rear of the analyser.
- Dust, corrosive vapours, dirt, etc. may affect the performance of the analyser.
- Select a 'clean' connection with a solid ground for the line voltage. Avoid connecting additional devices with high surge (peak) currents to the same line (outlet).
- Do not connect or disconnect system interface cables when the power is on.

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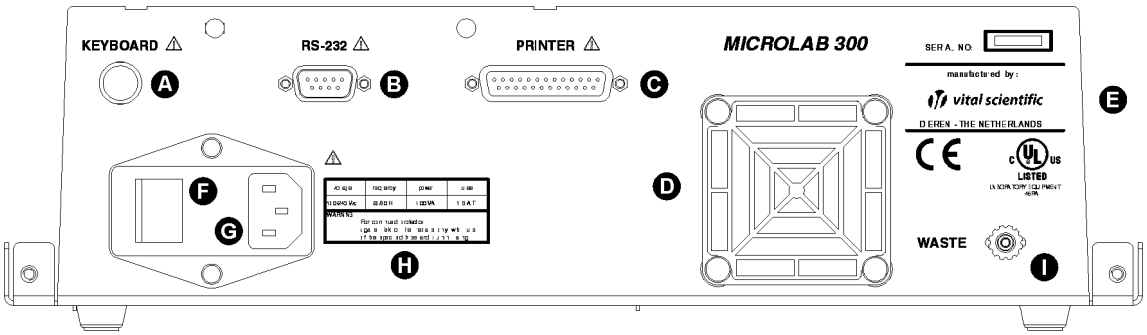
4.3.2 Installation

Connect the enclosed Teflon sipper tube, the waste tube (PVC) and the printer paper roll.

Please refer to the diagram below when installing the instrument.



- **A** PS/2 socket for external keyboard
- **B** RS-232 socket for connection to a host
- **C** Serial socket for connection to an external printer
- **D** fan
- **E** specific information about the instrument
- **F** fuse cover
- **G** socket for power cord
- **H** electrical information about the instrument
- **I** plug for to connect waste tube

4.3.3 Line voltage

The line voltage range is from 100 V AC to 240 V AC, 50/60 Hz as indicated on the identification plate at the rear of the analyser.

The mains cable supplied with the analyser is suitable for non-polarised 220 V outlets. For other power sockets, remove the plug and replace it with the correct plug.

Now connect the mains cable.

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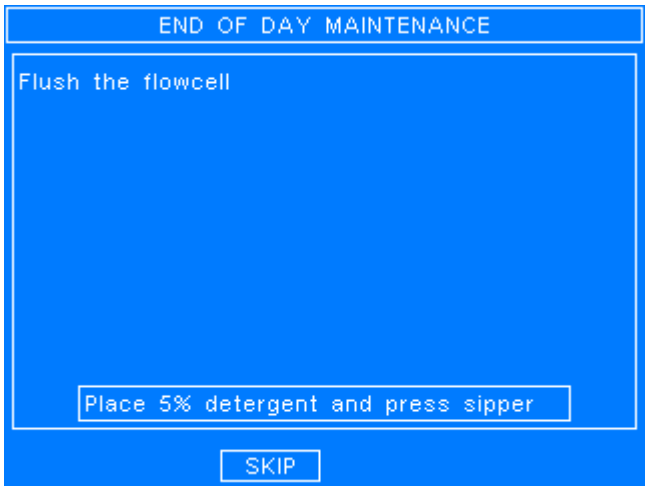
4.3.4 Turning on the instrument

Turn the analyser on by pressing the power switch at the rear of the analyser and wait for the start up display. The instrument carries out an initialisation and reset procedure.



Follow the instructions on the display to flush the flowcell. This procedure must be carried out to clean the fluid system thoroughly before the instrument is put into operation for the first time.

Please refer to chapter 7.4.5, "Maintenance", for a detailed description of cleaning the fluid system. Please refer to chapter 8.2.4, "Mechanical Reset", for a description of the mechanical reset procedure performed by the instrument when turned on or reset.

After starting up, allow the instrument to stabilise for 30 minutes. Measuring during this period is possible; however, results will be flagged with a "S".

4.3.5 Password levels

The analyser utilises two password levels, service and administrator. Use the following procedure to enter a password for the administrator access level.

- From the screen **MAIN MENU**, type 4 to access the **PROGRAM** menu.
- Type 2 to access the **SYSTEM CONFIGURATION** menu after entering the service password.
- Move the cursor to the PROTECTION category using the cursor keys and then press the enter key.
- Move the cursor to the ADMIN PWD text box using the cursor keys.
- Enter a password (between 3 and 6 characters) and then press the enter key.

Please also refer to chapter 8.4.4, "Changing the service level password".

For specific passwords please contact your dealer and/or Vital Scientific.

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4.3.6 Check lamp alignment

Check that the lamp is correctly aligned. If the lamp is not correctly aligned, realign it using the procedure described in chapter 10.6, "Replace and adjust lamp", in the User's Manual. Alternatively, choose USER MAINTENANCE from the MAIN menu of the instrument. In the MAINTENANCE menu, select ADJUST LAMP and follow the instructions displayed.

The analyser is now ready to use.

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4.4 Serial Interface (if required)

This section contains information on how to proceed if the analyser has to be connected to external data-handling equipment.

The instrument is equipped with an RS 232 compatible serial interface port. The connections are provided through a standard, female, 9-pole D-connector.

Please refer to the Appendix A.1.1.1, "Host – Target communication", table 1.

In order to establish a serial interface connection to an external device, it will be necessary to check the following:

- Baud rate
- Interface cable connections
- Software requirements.

4.4.1 Baud rate

The interface baud rate is programmable. To set the baud rate, use the procedure described in chapter 5.4.2, "Hardware", in the User's Manual.

The baud rate has a default value of 9600. If a different baud rate is set, it is kept until the instrument resets (switched off then on).

4.4.2 Interface cable connections

In addition to the previously described settings, the correct connections must be made on the interface cable to the external device.

Always consult the manufacturer's documentation for pin assignment of the interface connector of the external device.

Please refer to the Appendix, A.1.1.1 "Host – Target communication", table 1.

In general, the maximum length of a RS232 interface cable is specified as max. 10 meters.

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4.4.3 Software requirements

After establishing the serial interface format, baud rate and interface connections, the following must also be checked:

- Data format
- Character set
- Output buffer.

Note

This system works when a software handshake or heartbeat mechanism is being used.

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5. Physical Description of the Instrument

VITAL SCIENTIFIC N.V.

5 Physical Description of the Instrument

5.1 Overview

The analyser is a compact, state of the art instrument with a straightforward design. It has been engineered with a precise simplicity to ensure a high level of reliability.

Ease of maintenance and fast troubleshooting were taken into consideration during the design phase. The result is that all components selected were, where possible, from the manufacturer's 'off-the shelf' stock. Should a component fail, it can easily be replaced by Vital.

The units have been designed for plug-in replacement of circuit boards and major mechanical assemblies that permit on-site repair; thus ensuring an absolute minimum of instrument down-time.

In order to support the service technician, comprehensive test, diagnostic and alignment procedures have been included in the software.

5.2 Mechanical Design

The analyser consists of two major assemblies:

The baseplate assembly containing:

- Optical system
- Fluid system
- Processor board
- LCD display
- Printer.

The cover assembly containing:

- Top cover with keyboard
- Service cover.

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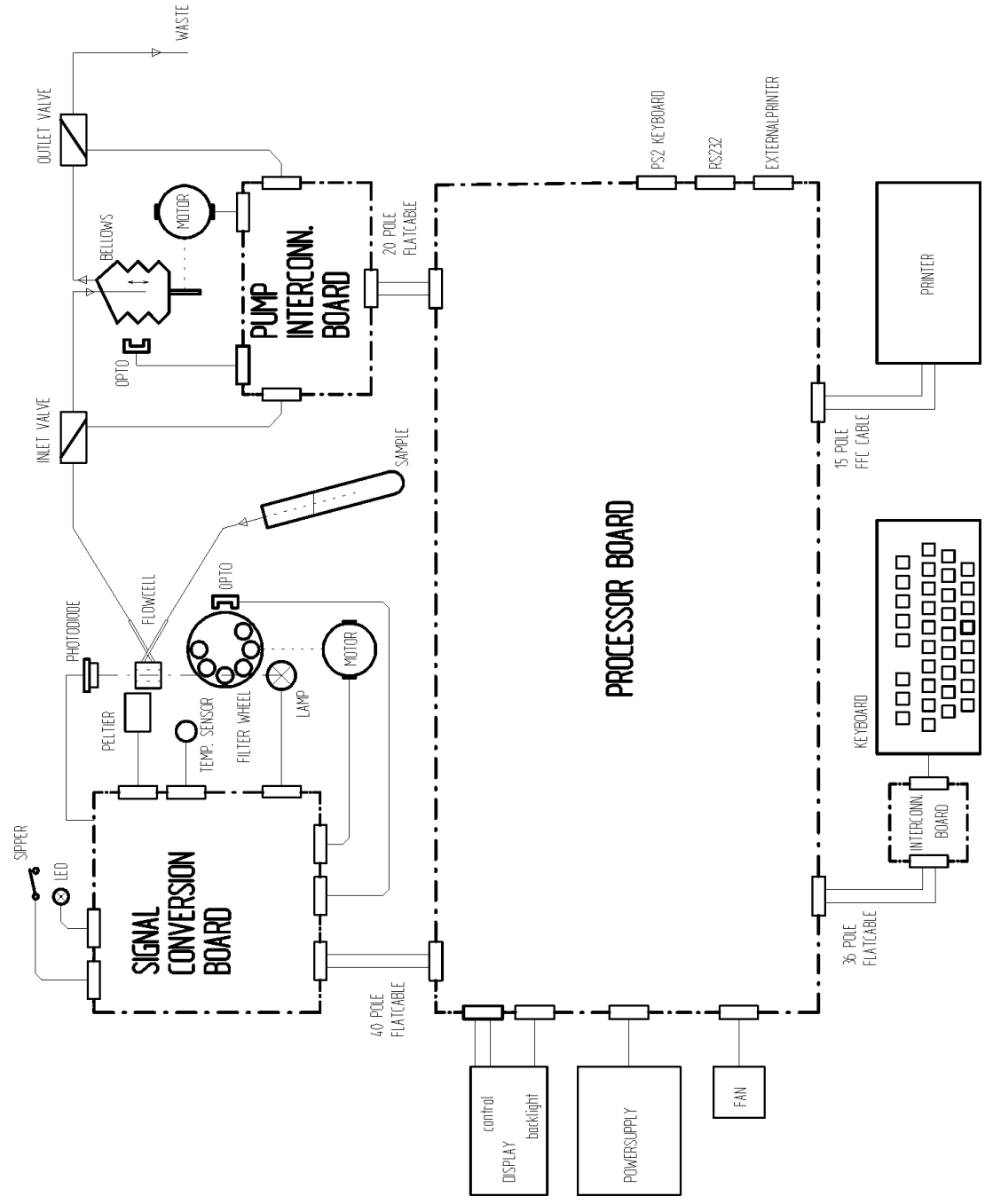
5.3 Schematic Diagram of System



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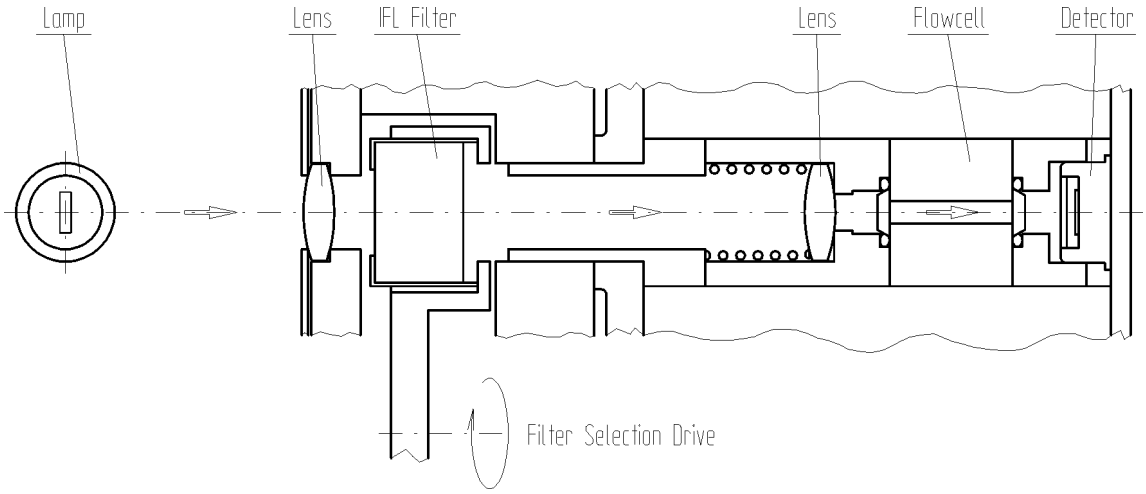
5.4 Optical System

As shown in the diagram below, the light source consists of a special, long-life 12 V / 20 W halogen lamp. The detector consists of a UV-enhanced silicone photocell.

Note

Only use an original spare part lamps. Ordinary lamps often have UV-blocking glass that causes the analyser to malfunction when measuring at 340 Nm.



The optical design has been kept as simple as possible.

The filament of the lamp is projected into the lens in front of the flow cell, whilst the diaphragm is projected just after the flowcell, creating a parallel beam in the flowcell.

Monochromatic light is achieved by using single IFL filters (interference line). The filters are mounted in a stepper motor driven, 12-position filterwheel. Depending on the test being carried out, the microcontroller will automatically set the filterwheel to the correct position as instructed by the software.

For the high wavelength range, a filter with a low transmittance is used to level out differences in energy at the low and high ends of the spectral range. This is necessary because the emission of the quartz iodine lamp and the spectral response of the detector are both much higher in the visible and near infrared range than the near ultra-violet range.

The lamp can be adjusted to optimise alignment for light via an arched adjustment range (see chapter 7, "Maintenance"). A set-screw is used to lock the lamp into position.

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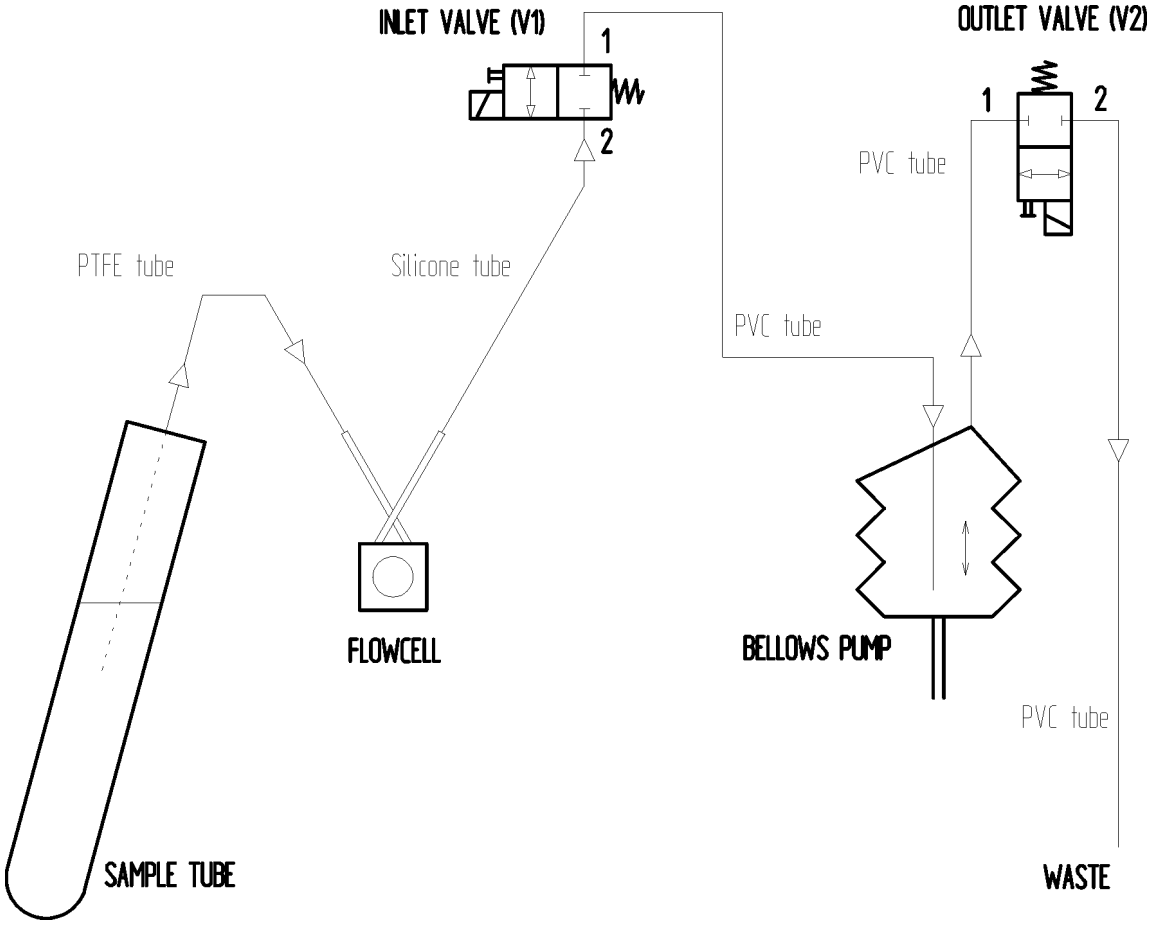
5.5 Fluid System

The fluid system consists of three major components:

- Flowcell
- Valve bracket assembly
- Bellows pump.



There are two major flow cycles, the Aspirate cycle and the Waste cycle.

During the Aspirate cycle, the inlet valve is open and the outlet valve is closed. The bellows of the bellows pump move downwards. Fluid is then aspirated through the sipper tube, the flow-cell, and the inlet valve to the inlet of the bellows pump. The bellows pump stops when the programmed volume has been reached.

During the Waste cycle, the inlet valve is closed and the outlet valve is open. The bellows of the bellows pump move upwards. Fluid is transported via the outlet of the bellows pump through the outlet valve to the waste outlet at the rear of the instrument.

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The bellows pump is designed in such a manner that the fluid always flows in one direction through the bellows pump to prevent clotting of the fluid.

The bellows pump is software controlled. When the instrument is switched on, the bellows move upwards until they reach their zero position, which is determined by an optocoupler. They then move downwards a little to a position that is registered as "zero". This means that during the aspirate cycle the bellows will move downward from this position and during the Waste cycle, upward as far as this position. When reset, the bellows return to the "zero" position.

The flowcell is made of stainless steel and has two connection pipes. The lower connection pipe is for the sipper tube (Teflon) and the upper, for the waste tube (silicone). The light-path of the flowcell is 10 mm and on both sides are sealed quartz windows. A Peltier element is used for temperature control of the flow cell. A temperature sensor is mounted on a small photometer board and is pressed into a hole in the flowcell.

Note

Cleaning instructions in the Operator's Manual must be observed for correct functioning of the system and to ensure "bubble-free" filling of the flowcell.

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5.6 Description of Function

This section provides some general information on the architecture of the analyser without going into detail of the electronic design.

5.6.1 System organisation and data structure

The microcontroller is responsible for overall functional control of the analyser. The program for the microcontroller is stored in flash memory with a total storage capacity of 2 Mbyte.

The system data memory is a non-volatile 512 Kbytes static CMOS RAM. A lithium battery, which is used as the back-up power source, will maintain the data for a period of at least 4 years after the instrument has been switched off.

The I/O structure of the system has been designed as a memory-mapped I/O. In such a structure, peripheral devices and functional circuits controlled by the microcontroller are part of the memory.

The interfaces between driver devices are controlled via I/O ports of the controller and via an in system circuit programmable logic device.

The LCD is controlled by an Epson SED 1335 LCD controller. The internal printer is controlled by an Epson LA180 controller. The RS 232 C serial interface is controlled by the UART of the C 167 controller.

5.6.2 Signal processing

The microcontroller can collect data at a rate of 40 measurements per second. From these 40 measurements, 20 are actual measurements derived from the sample currently in process. The other 20 are subsequent measurements derived from a fixed reference source. Each of these reference values is used to compensate the subsequent measurement value for deviations in the system.

The photometer board can, for descriptive purposes, be divided into two stages:

- Programmable input amplifier
- Vlin / Tlog converter (logarithmic A/D converter).

The first stage is an amplifier that has the UV-enhanced silicone photo-diode as an input source. The gain of this amplifier is software controlled and depends on the setting of four electronic analogue switches controlled via the I/O lines of the controller. The gain equals the power of 1.5 and can be programmed in 16 steps, from 1.5^0, which will produce a gain of 1 to 1.5^{15}, which will result in a gain of 438. The gain factor of 1.5 corresponds to an absorbance change of 17^6 mAbs (log 1.5 = 0.176).

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The output voltage from the programmable amplifier corresponds to the relative transmittance.

According to the law of Lambert Beer, the concentration/activity has a linear relation to the absorbance. Therefore the linear output voltage must be logarithmically converted in order to obtain the required absorbance from which the significant concentration/activity can be calculated.

The concentration is achieved by utilising the logarithmic discharge curve of a capacitor. The time, from the beginning of the discharge until the voltages from the input amplifier and the capacitor are equal, corresponds to the log of the measuring signal.

To eliminate errors caused by the temperature sensitivity of the circuit, a reference measurement is performed on a fixed precision voltage source with a nominal value after conversion of log 101 = 2.0043 Abs.

The discharge time is measured by starting a counter the instant the actual discharge is activated. The counter will be stopped the moment both voltages are equal (measuring voltage and capacitor voltage) The microcontroller controls the start of the counting and an accurate comparator determines the point where to stop (end of conversion).

Starting and stopping the input value of the logarithmic curve, as well as selection of the input value for the conversion, (detector or reference signal) is performed by electronic analogue switches controlled by the microcontroller.

The microcontroller is fed with a timer/counter that receives input from the system clock with a prescaler. At "end of conversion", the timer/counter contains the absorbance value of the sample in process or the reference value.

Every single measuring value is compensated by using the subsequent reference value according to the following calculations:

$$\text{Relative measuring value} = \text{measured value X } \frac{\text{nominal reference}}{\text{actual reference}}$$

The result of this calibration gives the absorbance value in units of 0.1 mAbs. However, the absorbance thus obtained is a relative value and must be corrected with a so-called "Absorbance Offset" value in order to find the absolute absorbance. The offset value is obtained during the automatic blank procedure.

When the automatic blank procedure is started, the microcontroller will perform a series of actions to determine the optimum gain factor for the programmable input amplifier. The gain is controlled in such a way, that the output voltage of the amplifier produces an absorbance value which fits within a specific window.

The absorbance thus obtained is referred to as "Absorbance Offset". Once determined it is memorised by the processor and subtracted from all following measuring values. When a reagent blank is measured, this value is also subtracted from all following values. The actual gain setting is performed by utilising a method of successive approach commonly used in A/D converter technology.

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5.6.3 Temperature control

Temperature control of the flowcell has been achieved by means of a small Peltier element mounted beside the flowcell.

Temperature sensing is performed by a smart temperature sensor, mounted in a hole in the flowcell. The sensor is a three-terminal integrated temperature sensor with a duty-cycle output. Two terminals are used for the power, with the third being used to carry the output signal.

The output signal from the sensor is fed to a timer/counter input of the microcontroller. The microcontroller verifies, via software, if the temperature is within range of 37 °C, +/- 0.2 °C.

If the set temperature of 37 °C is not reached within 30 seconds a temperature error will occur.

5.6.4 Testing and diagnostic routines

To support the technician, a number of test, diagnostic and alignment procedures have been included in the software.

Every time power is applied to instrument, the microcontroller automatically performs a power-on test. This test includes a check of all internal memory and when an error is detected, a continuous or intermittent audio alarm will sound.

The service menu provides access to several dedicated test routines by means of which various parts of the system can be checked and or adjusted. Please refer to chapter 8, "Tests and Diagnostic Procedures".

Note

The service engineer should refer to chapter 10, "Maintenance" in the User's Manual for half-daily and daily maintenance procedures that are to be carried out by the user.

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6. Technical Information

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6 Technical Information

6.1 Overview

This chapter explains the theory of operation of the analyser and is intended to help the service engineer to understand the design of the instrument and thus facilitate its maintenance and repair.

6.2 Instrument Component Groups

The instrument consists of the following components:

Baseplate assembly	Processor board Photometer board Optical block Switched power supply
Cover assembly	Display Keyboard Printer.

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6.3 Processor Board

The processor board controls the following system parts:

- Power supplies
- Microcontroller and logic core
- Integrated photometer board
- Light source control
- Temperature control
- Pump control
- Valve control
- Filterwheel control
- Sipper interface
- LCD interface
- Matrix keyboard interface
- PS2 keyboard interface
- Epson M-180 internal printer interface
- IEEE 1284 external printer interface
- RS232 communication interface
- Display.

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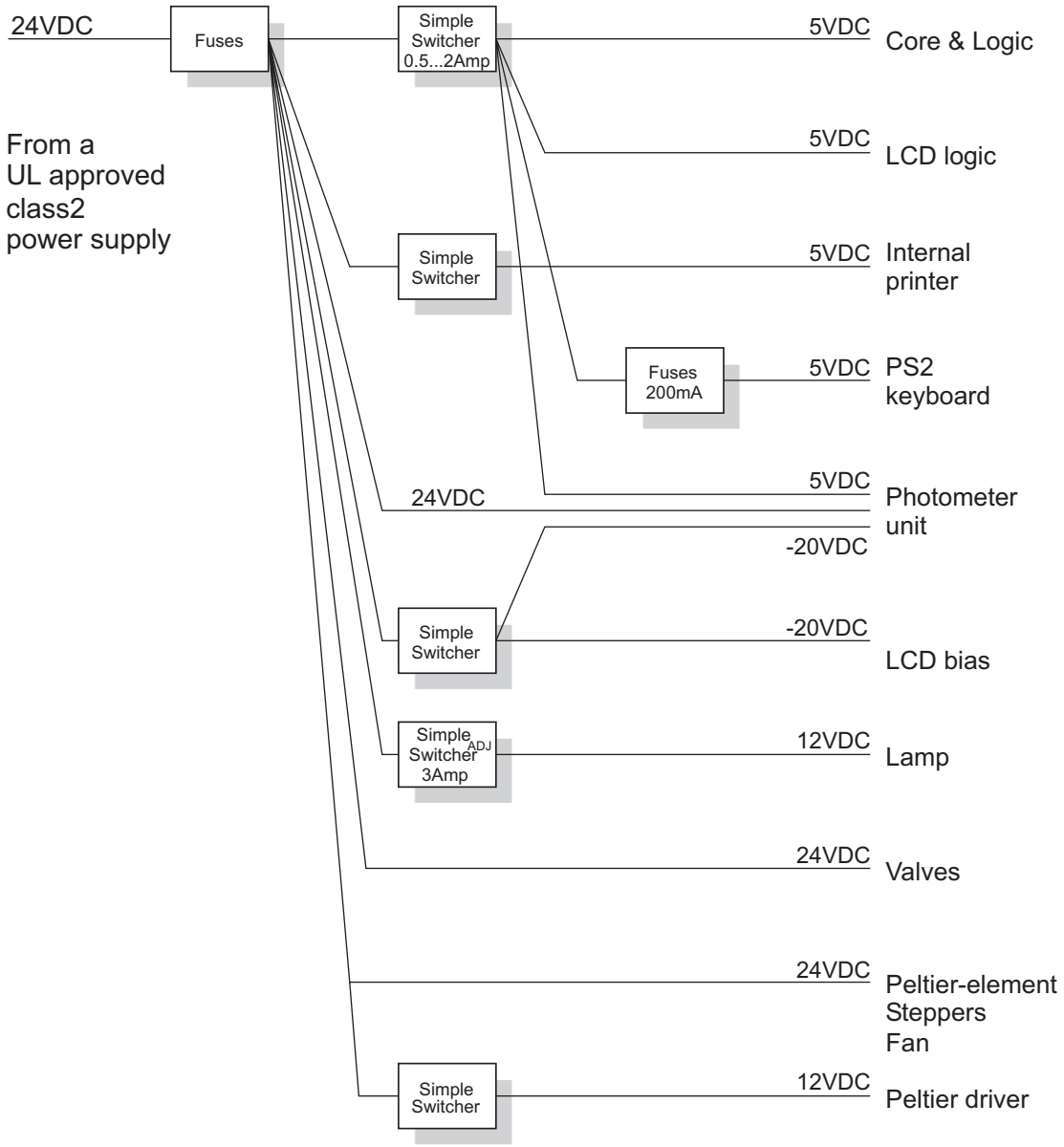
6.3.1 Power supply, detailed specifications

Power requirements: 24 VDC, limited by 2 resettable fuses, 2.5 A.

The power supply is distributed across the board to the different parts of the system as depicted by the following diagram.



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The logic power supply is 150 kHz switching step down regulator designed around a "Simple Switcher" with a fixed output voltage. It has been designed to supply max. 2 A at 5 V with an efficiency of approx. 80%. The regulator provides short-circuit and overheating protection. The short-circuit current is max. 4.5 A (peak). The absolute accuracy of the output voltage is approx. 4%.

The LCD bias supply –20 V is designed with a simple switcher in negative mode.

Please refer to the chapter 6.3.5, "Light source control" for information on the lamp supply.

Please also refer to the diagram 17 of 21 in the Appendix.

6.3.2 Microcontroller and logic core

The processor core supports all necessary input and output ports. The core has been designed to run at full speed without read wait states for both ROM and RAM. The programmable logic is used to provide access to the peripherals. Access to peripherals takes place via a multiplexed 8-bit wide databus. Test pins are provided for the most important nets, such as power and control lines. The RTC and SRAM devices are backed up by a 1000 mAh 0.5 AA lithium cell providing a data retention for a minimum of 4 years when the system is not being used.

Please refer to diagrams 2, 3 and 4 of 21 in the Appendix.

6.3.3 Signal conversion control

The external signal converter is constructed as visible-light-detector with a single-slope logarithmic converter. The measuring amplifier has an adjustable gain, which can be controlled through an SPI bus connection to the board. All signals are directly connected to the processor. The COMP input acts as counter gate input for timer 6 of the processor. This way a positive pulse on the COMP signal can be measured by special hardware inside the processor. Please refer to the manual of the C167 for details concerning this type of interface.

Please refer to diagram 5 of 21 in the Appendix.

Note

This interface requires no extra electronic circuitry apart from the processor.

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6.3.4 Light source control

The lamp power supply is a switching step down regulator, designed around a "Simple Switcher" with adjustable output voltage. It generates 11 VDC or 12 VDC from the main 24 V supply at max. 3 A with an efficiency of approx. 73%. The regulator provides short-circuit and over-heating protection. The short-circuit current is approx. 4.5 A. The lamp supply can be controlled by the microcontroller via two control lines. One line is for initiating shut down and the other is for the lamp saving mode. The control signals of the lamp are directly connected to I/O pins of the processor.

Please refer to diagram 7 of 21 in the Appendix.

6.3.5 Temperature control

Temperature regulation of the measuring cell is achieved via software. An externally connected "smart sensor", for example, type "Smartec" may be used for temperature measurement. This kind of sensor provides a digital PWM output signal that is directly connected to a processor input. The "Temp" input is selected for its capture / compare and interrupt capability. The temperature sensor is part of the integrated photometer board.

The drive section consists of a constant current source followed by a full-bridge power output driver stage, which is capable of handling 5 A. It is used to power an externally connected Peltier element for heating or cooling the flowcell. The output current can be set by a PWM output signal. Analogue input "Temp. in" has been provided for measuring the output current set by "Temp Pwm". This input is one of the 10-bit ADC inputs of the processor, which is capable of handling 0...5 V analogue signals. Output "Temp Pwm" has been selected for its PWM functionality to produce an analogue output signal. Outputs "Temp out1" and "Temp out2" each drive one half of the full-bridge output stage and signal "Temp Off" is used for switching the current source On or Off. "Temp Off" is provided as one bit in a register within the programmable logic. It has been combined with the master reset signal to ensure that the current source will automatically be switched off following a reset.

Please refer to diagram 8 of 21 in the Appendix.

6.3.6 Pump control

The pump motor driver is configured as a stepper-motor driver circuit with simple micorstep capability. The driver is able to halt on both full and half steps. The driver interface has been fully incorporated in to the programmable logic. All processor signals are gated through this interface. It is constructed as three separate registers. A 2-bit register for latching step signals and two 4-bit registers for programming phase currents. An 8-bit output latch is provided for synchronisation of all output signals. Output "Load_data" has specially been selected for its capture / compare functionality. The reset opto input has been selected for its interrupt capability.

Please refer to diagram 10 of 21 in the Appendix.

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6.3.7 Valve control

There are two valve outputs available. Both outputs are open-drain type outputs capable of sinking approx. 1 A. An ultra fast recovery, free running diode is provided for each channel. The output current is limited by the MOSFET itself.

Please refer to diagram 9 of 21 in the Appendix.

6.3.8 Filterwheel control

The filterwheel motor driver is configured as a stepper-motor driver circuit with simple micorstep capability. The driver is able to halt on both full and half steps. The driver interface has been fully incorporated in to the programmable logic. All processor signals are gated through this interface. It is constructed as three separate registers. A 2-bit register for latching step signals and two 4-bit registers for programming phase currents. An 8-bit output latch is provided for synchronisation of all output signals. Output "Load_data" has specially been selected for its capture / compare functionality. The reset opto input has been selected for its interrupt capability.

Please refer to diagram 6 of 21 in the Appendix.

6.3.9 Sipper interface

The sipper interface is actually a minimal user-interface providing a switch as input and an LED as output device. Both LED output and switch input are connected directly to the processor. The switch input has interrupt capability.

Please refer to diagram 5 of 21 in the Appendix.

6.3.10 LCD interface

The display interface is designed as a stand-alone interface with its own controller and memory. The master microcontroller interfaces to the video memory via the LCD controller. An external high-voltage (CCFL) controls the backlight. The LCD contrast can be controlled by the processor using a digital potmeter (X9c102S). Please refer to the datasheet for information on the potmeter interface.

Please refer to diagram 12 of 21 in the Appendix.

6.3.11 Matrix keyboard interface

The ROWx output signals must be fed back to the CLMx inputs by using mechanical-membrane switches. The scanning of the matrix inclusive the de-bouncing is implemented in the glue logic.

Please refer to diagram 13 of 21 in the Appendix.

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6.3.12 PS2 keyboard interface

This PS2 keyboard interface makes use of the Synchronous Serial Controller hardware inside the processor. The processor I/O pins are programmed to act as "Open Drain" type. Both Clock and Data are restrained with 1 kΩ resistors.

Please refer to diagram 13 of 21 in the Appendix.

6.3.13 Epson M-180 internal printer interface

The internal printer interface is built around the LAN printer controller. The printer is used only in a graphic mode. The interface lines are the most common IEEE 1284 I/O lines such as: D0 to D7, STRB, PF, SLIN, INIT, ACK, Busy.

Please refer to diagrams 15 and 16 of 21 in the Appendix.

6.3.14 IEEE1284 external printer interface

The printer incorporates three registers that are embedded in the programmable logic chip. The implementation of these registers is similar to the IBM compatible PC parallel printer interface. The difference being that none of the interface signals are inverted. Register-O is implemented as a read/write register, Register-1 as a write-only printer control register and Register-2 as a read-only printer status register. A 3-pin jumper has been added to select the output driver configuration: push-pull or open collector.

Please refer to diagram 14 of 21 in the Appendix.

6.3.15 RS232 communication interface

Please refer to diagram 11 of 21 in the Appendix.

6.3.16 Display

The liquid crystal display (LCD) module consists of the LCD display and a control board. Both parts are considered as one module mounted inside the top cover.

The module operates at a low voltage, has low power consumption and is suitable for graphic (240 x 320), figure and character display. As well as other devices, the controller also contains 64 Kbyte video RAM.

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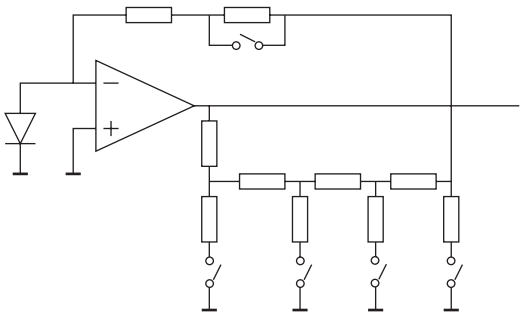
6.4 Integrated Photometer Board

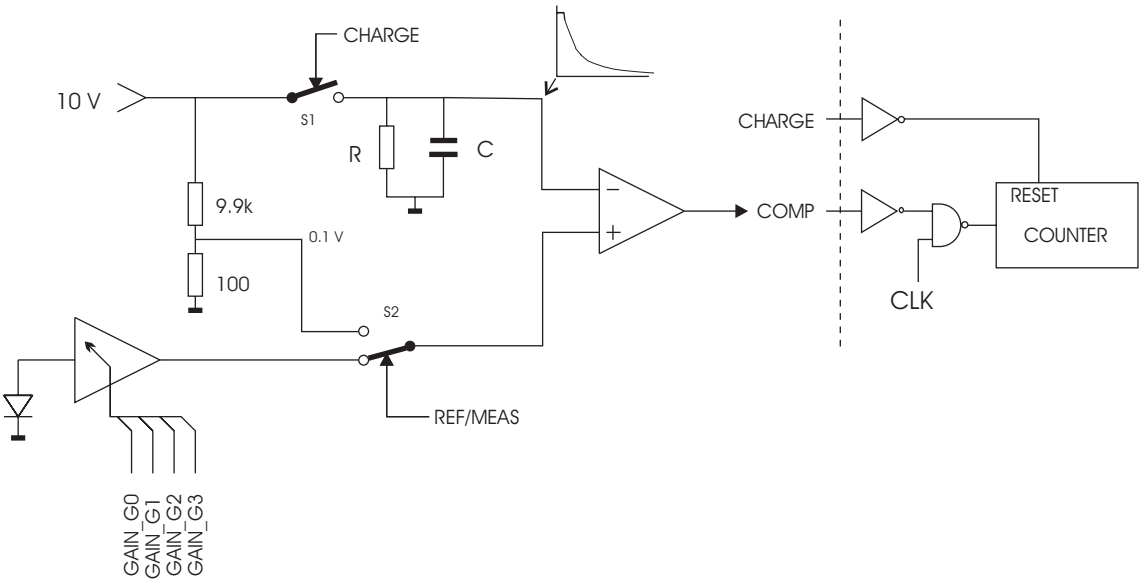
This board is mounted vertically behind the optical block and contains only the opto-switches for the filterwheel (reset position) and to detect if the prime lever is activated. This board has been designed to reduce the light coming from the lamp.

Signal conversion principle

The amount of light falling on the photodiode depends on the light energy from the lamp, the transmission of the chosen filter and the transmission of the sample in the tube. To capture the range of light, an input amplifier with a programmable gain has been chosen.



The principle diagram of the input amplifier is illustrated in the diagram above. An amplification with a so-called 'feedback tee' with different resistors in the tee network has been chosen in order to make the input amplifier programmable. The gain difference (per step) is equal to the power of 1.5 and can be programmed in 16 steps from $1.5^0 = 1$ to $1.5^{15} = 438$. Changing the amplification by 1 step will cause an ΔAbs. of log 1.5 = 0.176. At the minimum diode current, the output voltage of the input amplifier must be at least 10 Volt at gain 0. The feedback resistor can be calculated with both input current and output voltage. At gain 8, a higher feedback resistor will be switched into the feedback network. A high resistance feedback resistor is much better than a low resistor in a tee network.



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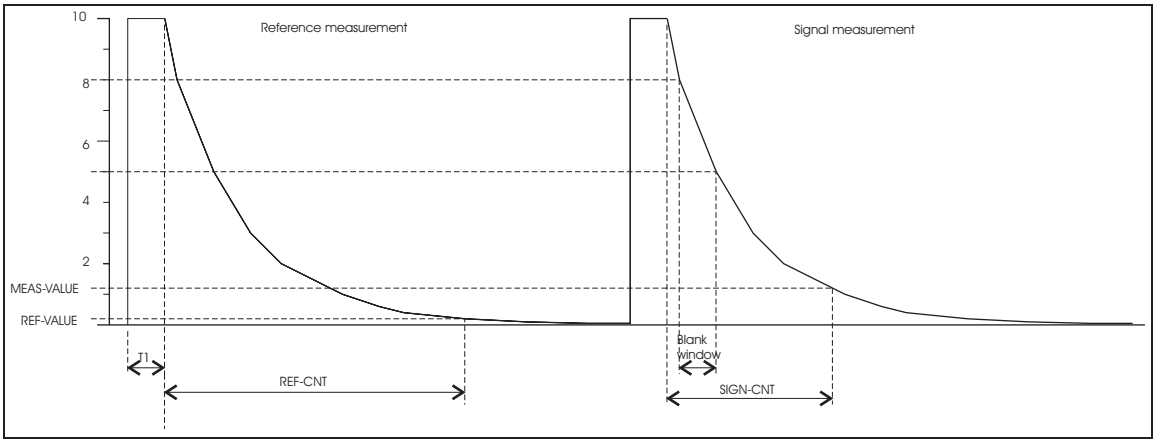
The analogue to digital conversion from the signal behind the input amplifier is achieved with a single-slope logarithmic A/D converter, diagram above. The essential parts of the converter are the logarithmic slope generator, the comparator, the reference voltage and the digital logic. The total conversion consists of two parts, the REFERENCE measurement and the SIGNAL measurement, see diagram below. One input of the comparator input is connected to the logarithmic slope generator and the other input of the comparator is connected via S2 to a reference of 10 / 100 Volt. With the CHARGE pulse, switch S1 is closed and the capacitor C of the logarithmic slope generator is charged with a voltage of 10 Volt, at the same time the binary counter is reset to zero. When the CHARGE pulse is low the switch S1 is open and the charged capacitor C discharges via resistor R. The output of the comparator is high, allowing clock pulses through the NAND gate to the counter. As soon as the logarithmic voltage curve crosses the reference voltage Uref, the comparator output will go low inhibiting clock pulses to the counter. The counter value REF-CNT represents the value log 100 = 2.0000. For the signal measurement, switch S2 is set to the output of the input amplifier. The conversion of the signal occurs in the same manner as the conversion of the reference. The counter value SIGNAL-CNT now represents the amplified photodiode current.

A relative value for the photodiode current is calculated with the following formula:

SIGNAL-MEAS = SIGNAL-CNT x 2.0000 / REF-CNT



Please refer to 21 of 21 in the Appendix.

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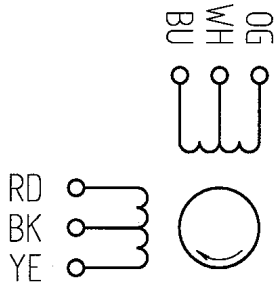
6.5 Power Supply

The following data applies to the power supply: a line voltage of 100/240 V nominal (tolerance 10%), a line frequency of 50/60 Hz (± 3 Hz) with a power consumption of max.100 VA. It is fused (part no. 3348-123) with a fast blow 3 A, 250 V (∅ = 5 mm x length = 20 mm).

6.6 Pump Unit

The pump unit is a bellows-type, stepper-motor driven double action (aspirate / dispense) pump with adjustable volume. For more detailed information, please refer to chapter 5.5, "Fluid System".



Layout of the stepper motor for the filterwheel and the bellows pump resistance 6.7 Ohm/phase.

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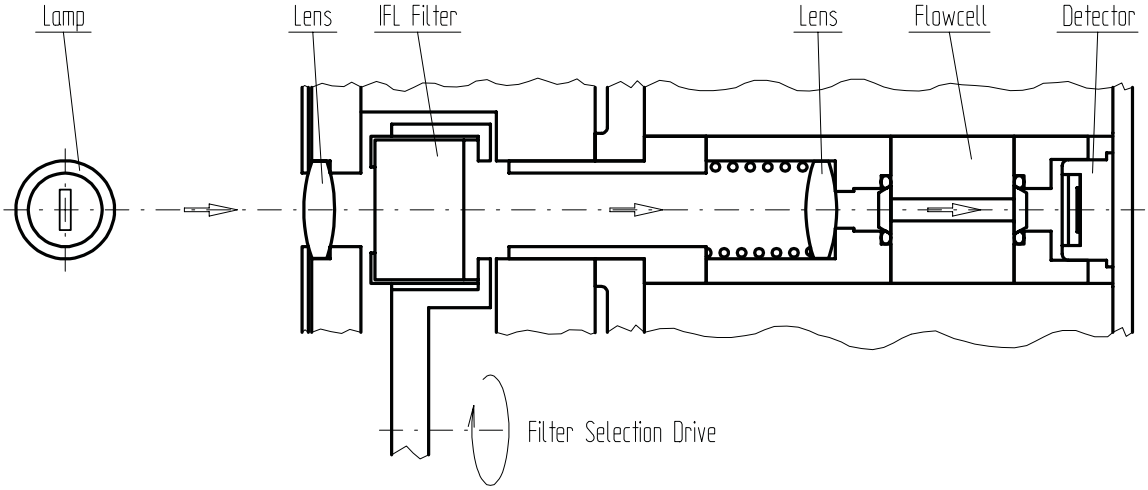
6.7 Optical Unit

The following table details the most important parts of the Measuring unit:

20 W halogen lamp (3380-018) (Please use only original lamps from Vital)	The halogen lamp has a lifetime of 1000 hours or more and can be easily replaced (see lamp replacement).
6 IFL filters (3067-xxx IFL filter) (Additional filters are available, please ask your dealer for details)	The filterwheel contains 6 filters mounted as standard: 1) 340 nm 4) 546 nm 2) 405 nm 5) 578 nm 3) 505 nm 6) 620 nm The configuration can be changed by adding a new filter and programming the related wavelength in the system parameters.
Detector (3060 053)	Lens 8 mm F13.5
Flowcell (6002-345)	The flowcell unit, shown below, can be seen as the heart of the instrument.



6.8 Printer

- Integrated impact dot-matrix printer
- 20 columns of text
- Graphics
- 140 dots per line
- exchangeable ribbon cartridge.

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7. Maintenance

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7 Maintenance

7.1 Overview

The analyser is designed to operate with a minimum of maintenance and adjustment. Repair equipment is kept to a minimum and common tools are required in most cases.

Note

Maintenance procedures to be performed by the user are described in the User's Manual.

7.2 Preventative Maintenance

To assure that the analyser operates at its optimum design potential and to assure high MTBF (Meantime Between Failure), a program of scheduled preventative maintenance is recommended. This maintenance, which should be carried out by the operator, includes:

- Cleaning the outside of the analyser
- Cleaning fluid system
- Lamp replacement and adjustment
- Fuse replacement.

Please refer to chapter 10, "Maintenance", of the User's Manual for a comprehensive explanation of these procedures.

We recommend that the condition of the tubing be checked every 6 months and replaced whenever necessary. Check if the tubes are open and see if there is any algae and /or bacteria growth. If so please flush the system with detergent or replace the tubes.

Replace the halogen lamp at least once a year.

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7.3 Yearly Maintenance

Yearly maintenance should be performed at least once a year. It is possible that Items such as tubing or the foam filter in the ventilator may need to be cleaned or exchanged more frequently due to environmental conditions in the laboratory. Please check the foam filter in the ventilator at least every 2 months.

Note

It is imperative that appropriate measures be taken to prevent Electro Static Discharges when carrying out maintenance on the instrument (for example, wearing a wrist band or heel straps).

The following tools and equipment are required to carry out yearly maintenance:

Equipment

4½ digit DVM

Tools

Philips screwdriver recess size 1

Allen key (4 mm)

Parts	**Part number**
Micro Series Tubing	
Sipper tubing, Teflon	1503-008; L = 255 mm (L = 1 m when ordered)
Tubing pump unit, PVC	1513-052; L = 75 mm; [2x] (L = 5 m when ordered)
Waste tube assy	6002-330 [complete assy]
Tubing, PVC	1513-052; L = 68 mm (L = 5 m when ordered)
Tubing, PVC	1513-024; L = 240 mm (L = 1 m when ordered)
Connector	30666-141
Flowcell tube assy	6002-331 [complete assy]
Tubing, PVC	1513-052; L = 52 mm (L = 5 m when ordered)
Tubing, silicone	1573-001; L = 30 mm (L = 1 m when ordered)
Socket	3066-146
Male luer connector	3066-147
Bellows	4100-347
Pump O-ring	3029-039
Lamp (12 V/20 W)	3380-018
Filter foam (ventilator)	3370-762

Approximately 1 hour is required for these service actions.

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7.4 Maintenance Procedures

The following procedures describe how to disassemble the most important parts of the analyser for maintenance.

Note

Part numbers are given in brackets.

7.4.1 Cleaning the cover

The top cover (3070-471) and the service cover (3070-470) can be cleaned with wet tissues or a foam cloth. Do not use abrasive materials or alcohol.

7.4.2 Emptying the fluid system

Before carrying out maintenance on the fluid system, the system should first be drained. Use the following procedure to empty the fluid system.

1. Turn the power on and wait for the start-up screen to appear on the display.
2. Ensure no liquid/detergent is placed under the sipper and continue with the flow cell flushing process.

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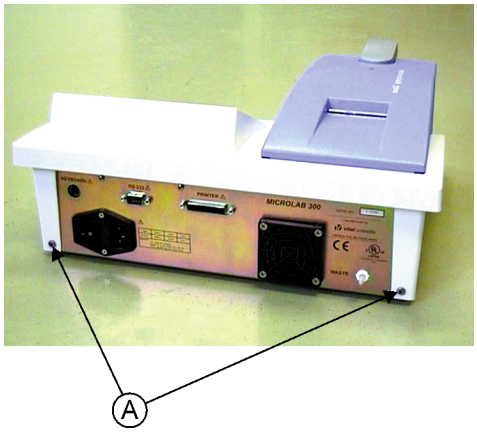
7.4.3 Removing covers

It is necessary to remove the covers to access the parts of the analyser for maintenance. The following procedures are offered as a guideline for their safe removal.

Warning

Ensure that the power supply to the analyser is switched off before removing the covers.



1. Lift off the blue service cover holding it at the front.
2. Remove the two screws (A) securing the top cover at the rear of the instrument.
3. Remove the top cover by raising it at the back and sliding forwards.

The flat cable connecting the keyboard in the top cover to the microprocessor board is long enough for the top cover to be laid beside the analyser. However, the flat cable can be disconnected at either end if necessary.

7.4.4 Cleaning the base plate

1. Remove the analyser's covers (see above).
2. Clean all dust and particles of dirt from the analyser using dry compressed air or a vacuum cleaner with a soft brush.

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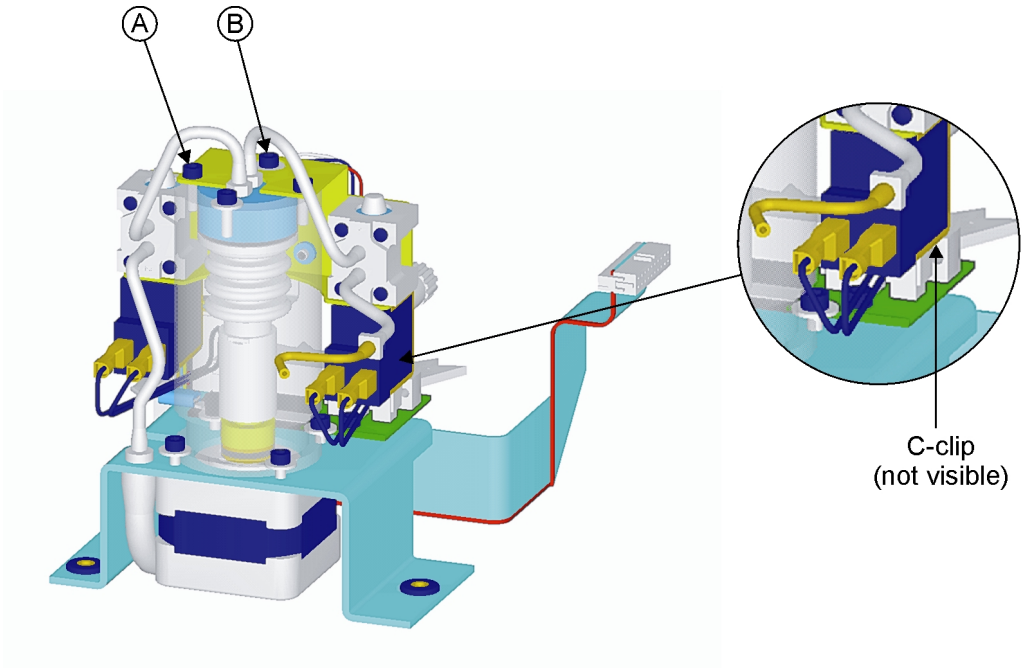
7.4.5 Cleaning the fluid system

It is important to maintain a clean fluid system in order to guarantee accurate results. Use the following procedure to thoroughly clean the fluid system.

1. Empty the fluid system.
2. Remove the analyser's covers (see 7.4.3).



3. Disconnect and remove all tubing of the fluid system, sipper tubing (1533-008), waste tube assy, flowcell tube assy and pump unit tubing (1513-052).
4. Remove the valve bracket assembly by unscrewing the two screws (A) on top of the pump unit .
5. Remove the cover assy by gently unscrewing the two screws (B) on top of the pump unit.

Note

The bellows act like a spring and may cause the cover to jump off.

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Caution

The bellows do not empty completely and therefore may contain biohazardous material. Wear protective gloves when removing the bellows and clean any spills immediately using a disposable tissue and disinfectant.

6. Remove the bellows (4100-347) by unscrewing the screw at the base of the bellows and lifting them out of the pump unit housing.
7. Clean the bellows, the bellows O-ring (3029-039), the pump unit cover and the inside of the pump unit housing.
8. Replace the bellows, the bellows O-ring, and the pump unit cover, secure them with the two screws (B).
9. Replace the valve bracket assembly.
10. Reconnect the fluid system using new tubing.
11. Replace the analyser's covers.
12. Flush the analyser with a solution of redistilled water and 5 – 10% neutral detergent (e.g. Mucasol or Extran neutral) at 37 °C for at least 10 minutes (please refer to the appendix for a diagram of the flush routine).
13. Flush the analyser with redistilled water for a further 5 minutes.

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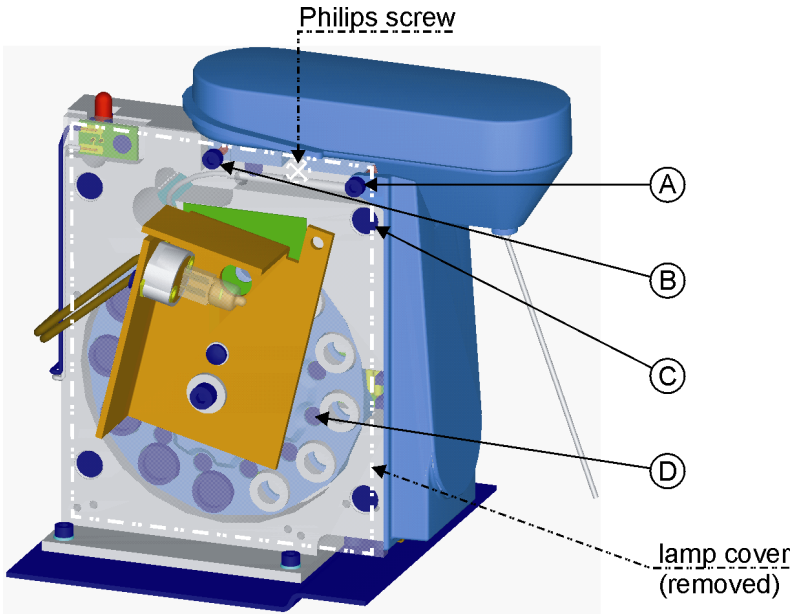
7.4.6 Mounting IFL filters

The analyser is delivered with 6 filters of different wavelengths. There are 12 positions for filters on the instrument. If new tests are added, it may be necessary to add extra filters. Please contact your local agent should you require further filters. Follow the procedure below to replace or add new filters.

1. Remove the analyser's covers (see 7.4.3).



2. Remove the sipper lever and housing by unscrewing the two Allen screws (A) and (B) at the top of the lever (please note that one screw (A) is hidden from view). Remove the Philips screw at the top of the mount plate assembly to remove the lamp cover.
3. Remove the front assembly from the optical unit by unscrewing the four Allen screws (C) and move it aside.
4. Loosen the screw (D) securing the dummy in the position into which the filter is to be mounted.
5. Remove the dummy filter, and replace with the new filter. Take care not to touch the flat, optical surfaces of the filters.
6. Fasten the screw under the position.
7. Replace the front assembly.
8. Replace sipper housing and lever.
9. Replace covers.
10. Analyser will perform reset when turned on.

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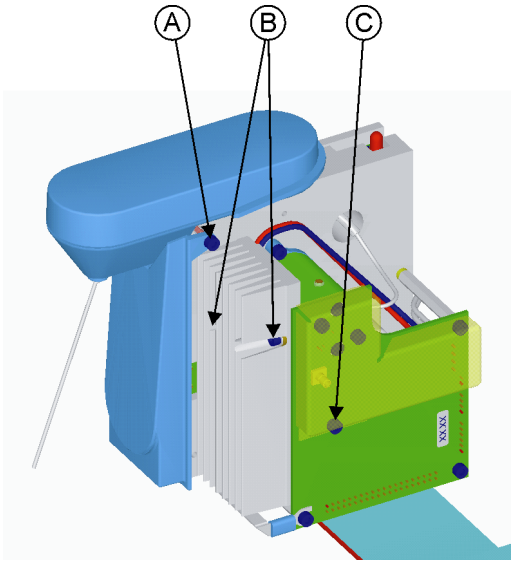
7.4.7 Removing / replacing the flow cell

1. Empty the fluid system.
2. Remove the analyser's covers (see 7.4.3).



3. Remove the sipper lever by unscrewing the two screws (A) at the top of the lever (please note that one screw (A) is hidden from view).
4. Remove the heatsink by unscrewing the two screws (B) securing it to the flow cell housing. Attention, peltier element will come loose.
5. Remove photometer board cover (4801-142) by unscrewing the screw (C) securing it to the photometer board.
6. Remove the photometer board by unscrewing the three screws securing it to the optical unit as well as the two screws securing it to the flow cell housing.

Caution

Remove the photometer board with care.

7. Disconnect the tubing from the flow cell (you may find it useful to apply sandpaper to help manipulate the Teflon tube).
8. Remove the flow assembly from the measuring unit by unscrewing the three screws securing it to the measuring unit and gently sliding the assembly out.

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Caution

When replacing the assembly, it is important to reconnect the tubing to the flow cell in the correct orientation (Teflon tube to the lower flowcell tubing connection) and the Peltier element is in the correct orientation (black wire on top).

Use conductive paste when inserting the temperature sensor. Ensure that it is not inserted at an angle.

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7.4.8 Replacing the lamp

Use only original lamps from Vital 3380-018. Ordinary lamps are often made with UV-blocking glass that absorbs part of the light spectrum resulting in distorted measurements.

1. Remove the service cover (see 7.4.3).
2. Remove the lamp cover by removing the screw.

Caution

The lamp cover may be hot if the instrument has been in operation for some time.

3. Remove the old lamp and replace it with the new one. Remember the lamp may be hot.

Note

Take care not to touch the lamp directly with your fingers as this will contaminate the lamp.

4. Adjust the lamp according to the procedure described in chapter 10.6, "Replace and adjust lamp" in the User's Manual or follow the procedure described below in chapter 7.4.9, "Adjusting the lamp ".
5. Replace the lamp cover.
6. Replace the service cover.

7.4.9 Adjusting the lamp

1. Remove the service cover (see 7.4.3).

   Please refer to chapter 10.6, "Replace and adjust lamp" in the User's Manual for a more detailed explanation of this procedure or alternatively, proceed as follows:

2. Select **USER MAINTENANCE** from the **MAIN** menu using the cursor keys or by pressing the number 5 on the keyboard. Then select **Adjust lamp** using either the cursor keys or by pressing the number 3 on the keyboard.
3. Follow the procedure given in the software.
4. Replace the lamp cover.
5. Replace the service cover.

Caution

The lamp cover may be hot if the instrument has been in operation for some time.

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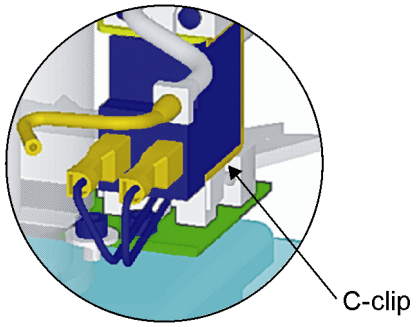
7.4.10 Replacing a valve

If the valves are malfunctioning, use the following procedure to replace them.

1. Empty the fluid system.
2. Remove the analyser's covers (see 7.4.3).
3. Disconnect the tubing to the affected valve (3366-922).

Caution

When removing, the tubing may contain biohazardous material. Wear protective gloves and clean away any spills immediately using a disposable tissue and disinfectant.



4. Disconnect wiring to the valve.
5. Slide off the C-clip (see above) from under the actuator of the affected valve.
6. Slide the valve out of the actuator.
7. Replace the valve with a new one, and replace the C-clip.
8. Reconnect the wiring to the valve.
9. Reconnect the tubing (inlet on top).
10. Replace the analyser's cover.

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7.4.11 Replacing the bellows

1. Empty the fluid system.
2. Remove the analyser's covers (see 7.4.3).
3. Disconnect the tubing to the pump unit (see 7.4.12).

Note

Please remember the type and position of the tubes.

4. Remove the valve bracket assy by unscrewing the two screws (A) on top of the pump unit as indicated in the drawing in chapter 7.4.5, "Cleaning the fluid system".
5. Disconnect the optocoupler connector at the interconnector board.
6. Remove the cover assy by gently unscrewing the two screws (B) on top of the pump unit as indicated in the drawing in chapter 7.4.5, "Cleaning the fluid system".

Note

The bellows act like a spring and may cause the cover to jump off.

7. Remove the bellows (4100-347) by unscrewing the screw at the base of the bellows and lifting them out of the pump unit housing and replace them with the new bellows. Replace the screw and secure with Loctite.

Caution

The bellows do not empty completely and therefore may contain biohazardous material. Wear protective gloves when removing the bellows and clean away any spills immediately using a disposable tissue and disinfectant.

8. Replace the bellows O-ring (3029-039), and secure the pump unit with the pump unit cover.

Note

Please ensure the correct positioning of the vane/optoboard.

9. Replace the valve bracket assembly.
10. Reconnect the tubing.
11. Replace the analyser's covers.

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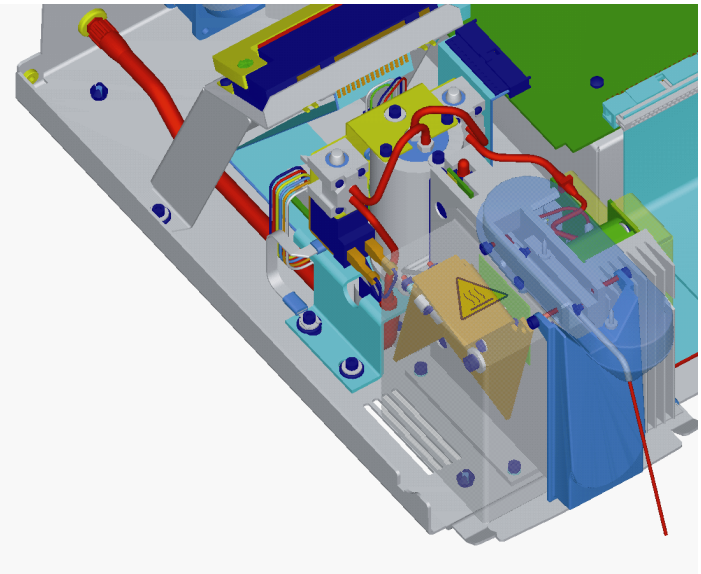
7.4.12 Replacing tubes

Tube	Part number
Sipper tubing, Teflon	1503-008; L = 255 mm (L = 1 m when ordered)
Tubing pump unit, PVC	1513-052; L = 75 mm; [2x] (L = 5 m when ordered)
Waste tube assy	6002-330 [complete assy]
Tubing, PVC	1513-052; L = 68 mm (L = 5 m when ordered)
Tubing, PVC	1513-024; L = 240 mm (L = 1 m when ordered)
Connector	30666-141
Flowcell tube assy	6002-331 [complete assy]
Tubing, PVC	1513-052; L = 52 mm (L = 5 m when ordered)
Tubing, Silicone	1573-001; L = 30 mm (L = 1 m when ordered)
Socket	3066-146
Male luer connector	3066-147

Please follow the procedure below when replacing the tubes on the instrument.

1. Empty the fluid system.
2. Remove the analyser's covers.



3. Carefully disconnect all the tubing and replace it with new tubing.

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Caution

Some fluid may remain in the tubing that could contain biohazardous material. Wear protective gloves when removing the tubing and clean any spills immediately using a disposable tissue and disinfectant.

7.4.13 Replacing fuses

There are three fuses used in the analyser. Please refer to the User's Manual for a detailed explanation on how to replace the two fuses at the rear of the instrument.

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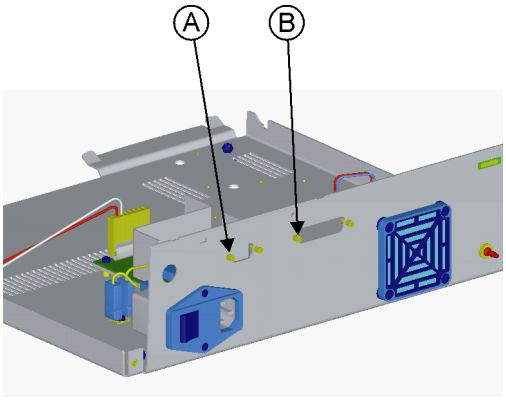
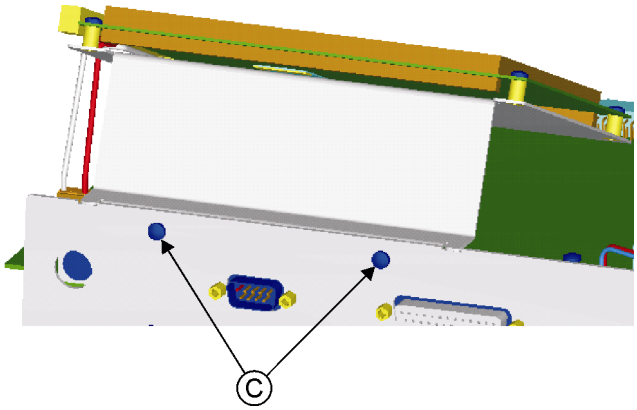
7.4.14 Replacing fuse on power supply (mains)

1. Remove the covers (see 7.4.3).



2. Remove the screws (A) and (B) from the rear of instrument (total of 4).



3. Remove the 2 Philips screws (C) securing the display at the rear of the instrument.
4. Remove screw fixing display to spacer.
5. Disconnect power cord to back light.
6. Disconnect flat cable by lifting outer part of bayonet and slide flat cable out.
7. Remove 4 screws securing processor board.
8. Remove all connectors to processor board.
9. Remove the two screws securing the PCB mounting plate.
10. Replace the fuse on the power supply (3348-123).
11. Reassemble the instrument.

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8. Tests and Diagnostic Procedures

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8 Tests and Diagnostic Procedure

8.1 Overview

This chapter contains information concerning the comprehensive test, diagnostic and alignment procedures included in the software of the analyser. These are designed to ensure the efficient running of the system and support the service technician in carrying out maintenance and troubleshooting tasks.

8.2 Power On Check

Each time power is applied to instrument, the microprocessor automatically performs a power-on test to check the correct functioning of the microprocessor and system memory. This test includes a check of internal memory. The analyser checks the correct functioning of the RAM memory by writing certain data and reading it. The flash memories are tested by a checksum test. When an error is detected, a continuous or intermittent audio alarm will sound. When everything goes well one 'beep' is heard during the start-up of the Micro Series.

8.2.1 RAM test

A series of tests is performed to determine whether or not the writing and reading of data to RAM functions properly:

- The first test checks if the data line remains high, if that is the case an error has occurred and three 'beeps' will be heard.
- The second test checks if the data line remains low, if that is the case an error has occurred and four 'beeps' will be heard.
- The third test checks if the address lline remains high, if that is the case an error has occurred and five 'beeps' will be heard.
- The fourth test checks if the address lline remains low, if that is the case an error has occurred and six 'beeps' will be heard.

8.2.2 Non-volatile RAM test

The integrity of the persistent data that's stored in RAM is tested during the Micro Series start-up procedure. If the integrity check fails, the persistent data will be cleared. When that part of the integrity test fails that checks if the retrieved data is correct, then a RAM hardware failure or version conflict has occurred and a continuous beeping sound will be heard.

8.2.3 FLASH MEMORY test

During this test the contents of the program memories (flash memory) are tested. This is done by adding the contents of all addresses according to a specified calculation and comparing the result of this addition to a single byte checksum stored in the flash memory.

If an error is detected, two 'beeps' are generated.

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8.2.4 Mechanical reset

The analyser performs a reset on the bellows pump and the filterwheel to establish the "zero positions".

The following two situations can occur when the pump is being reset:

1. The vane position is not in the opto

   First the inlet valve is closed and the outlet valve is opened.
   Next the bellows pump moves up until a transition is detected by the reset opto. Following detection the bellows pump moves down 1000 steps, followed by moving up again until a transition is detected. Then the pump moves up another 200 steps. This position is called the reset position and is the starting position for new aspirate actions.
   Finally the outlet valve is closed.

2. The vane position is in the opto

   First the inlet valve is closed and the outlet valve is opened.
   Next the bellows pump moves down until a transition is detected by the reset opto. Following detection, the pump continues to move down another 1000 half steps. The bellows pump then moves up until the transition is detected by the reset opto. Thereafter the pump moves up 200 steps. This position is called the reset position and is the starting position for new aspirate actions.
   Finally the outlet valve is closed.

If an error occurs during the reset procedure, the following message will be displayed:

009 Pump init. fails

8.2.5 Filterwheel reset

The filterwheel is brought to a defined position determined by the path of light through the flow-cell. After initialisation, the filterwheel is positioned so that reset position (dark position) blocks the path of the light through the flowcell.

First the stepper motor of the filter wheel is enforced, so that the stepper motor will be fixed at it's reset position.
Secondly, the filterwheel is rotated 2½ times, so that the reset position will be estimated with the aid of the optical switch when passing the notch at a constant speed.
Finally the filterwheel is set to it's reset position, so that when the filterwheel isn't being used it blocks the path of the light through the flow cell. This is the position of the filterwheel when it is not operating.

If an error occurs during the reset procedure the following message is displayed:

010 FW Init. fails

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8.3 Internal Diagnostics

During measurements, the analyser checks the reference voltage (please refer to chapter 5.6.2, "Signal processing" for a description of the Vlin/Tlog converter). When this check fails, the following error message is displayed: 002 Ref. out of range. This error message is generated if the reference source, which has a nominal value of 2004.3 mAbs, becomes less than 1874.8 mAbs or more than 2338.3 mAbs.

8.4 Service Level Software

This section deals with the **SYSTEM SETTINGS** menu, which is only available to the service technician. The service level password is required to access the software functions described below. This ensures that unauthorised personnel are not able to take incorrect actions that may result in damage to the instrument or lead to false test results.

Note

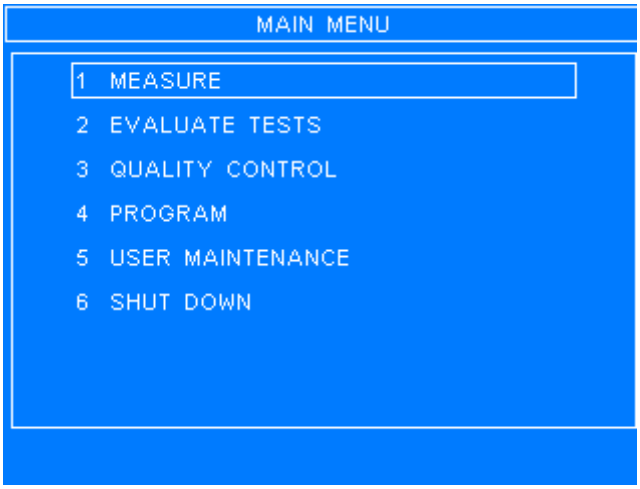
Press the PRINT softkey if you require a printout of the settings in the **SYSTEM SETTINGS** menu. No printout is available for the PROTECTION category.

Press the BACK softkey to leave the **SYSTEM SETTINGS** menu and return to the **Program** menu. To return to the **MAIN** menu, press the BACK softkey again.

The following categories can be accessed only by the service technician:

Adding filter wavelengths	see chapter 8.4.1
Setting the transport volume	see chapter 8.4.2
Defining the number of open channels	see chapter 8.4.3
Changing the service level password	see chapter 8.4.4

Follow the procedure below to access the **SYSTEM SETTINGS** menu:



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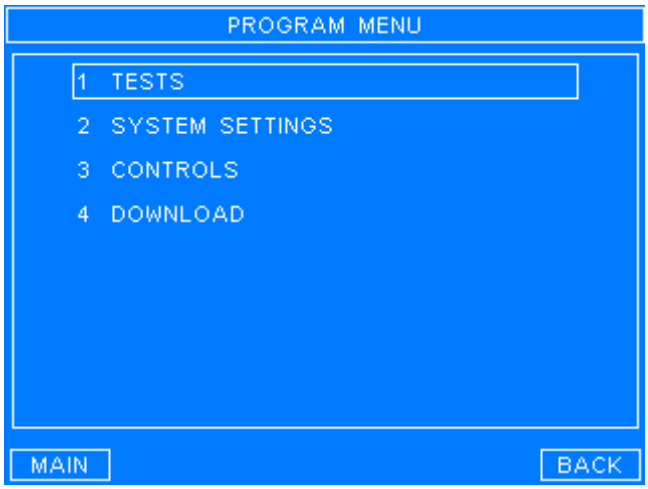
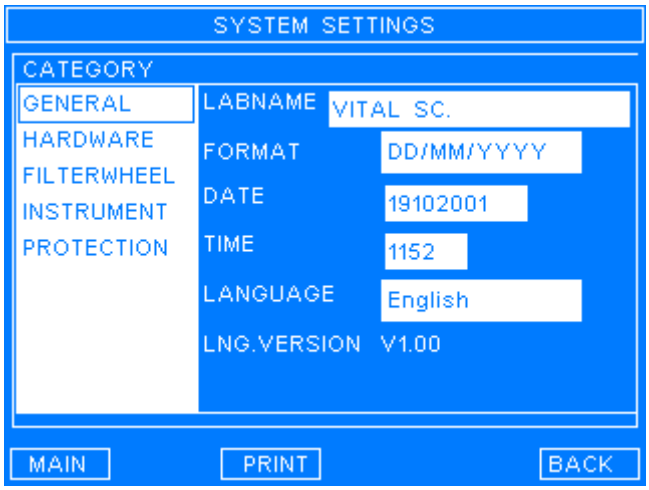
1. Choose **PROGRAM** from the **MAIN** menu using the cursor keys and then press the Enter key. Alternatively, press the number 4 on the keyboard.



2. Choose **SYSTEM SETTINGS** from the **PROGRAM** menu by using the cursor keys and then press the Enter key. Alternatively, press the number 2 on the keyboard.

3. Type in the service level password to access the **SYSTEM SETTINGS** area of the software at the service level.

4. Press the Enter key to confirm your password. Access to the service level of the software will be denied if the wrong password is used. The following screen is displayed:



Note

Please observe, when using an external keyboard the password function is case-sensitive.

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8.4.1 Adding filter wavelengths

When adding new filters, please refer to chapter 7.4.6, "Mounting IFL filters". Adding a new filter requires that the corresponding wavelength be entered into the FILTERWHEEL category. This is also the case if an existing filter is exchanged for a new filter with a different wavelength or the order of the filters on the filterwheel is altered. Follow the procedure below to add or alter a wavelength of the corresponding filter:

1. Choose the FILTERWHEEL category using the Up/Down cursor keys.
2. Press the Enter key or use the Left/Right cursor keys to focus the cursor on the right hand side containing the filterwheel settings.
3. Press the Enter key to navigate to the position that corresponds to the position with the new filter.
4. Type in the wavelength in the edit box.
5. Return to the FILTERWHEEL category on the left using the Left/Right cursor keys.

8.4.2 Setting the transport volume

Follow the procedure below to increase the transport volume by the required amount.

1. Choose the INSTRUMENT category using the Up/Down cursor keys.
2. Press the Enter key or the Left/Right cursor key to access the TRANSPORT VOL. edit box.
3. Delete the existing transport volume using the Backspace key.
4. Type in the required volume using the number keys.

Note

Please note that the transport volume is set in microliter µl.

8.4.3 Defining the number of open channels

This function allows the service technician to determine the number of tests that can be carried out on the instrument. The maximum number is 60. Follow the procedure below to enter the required number of possible tests:

1. Choose the INSTRUMENT category using the Up/Down cursor keys.
2. Navigate to the # OPEN CHANNELS edit box using either the Enter key or Left/Right cursor keys.
3. Delete the existing number of open channels using the Backspace key.
4. Type in the required number.

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8.4.4 Changing the service level password

The service technician can change both the LABORATORY PWD and the SERVICE ENG. PWD.

Follow the procedure below to change the service level password:

Note

Great care should be taken when changing the password at this level. Unauthorised personnel must not have access to the password at this level.

---

1. Choose the **PROTECTION** category using the Up/Down cursor keys.
2. Navigate to either the SERVICE ENG. PWD edit box or the LABORATORY PWD edit box using either the Enter key or Left/Right cursor keys.
3. The existing password is not visible. The actual number of characters contained in the password are depicted in the following manner ****.
4. Delete the existing password in the edit box using the Backspace key.
5. Type in the new password using the alphanumeric keys. The password must contain between 3 and 6 characters.
6. Press either the Enter key or the Left/Right cursor keys to return to the PROTECTION category on the left.

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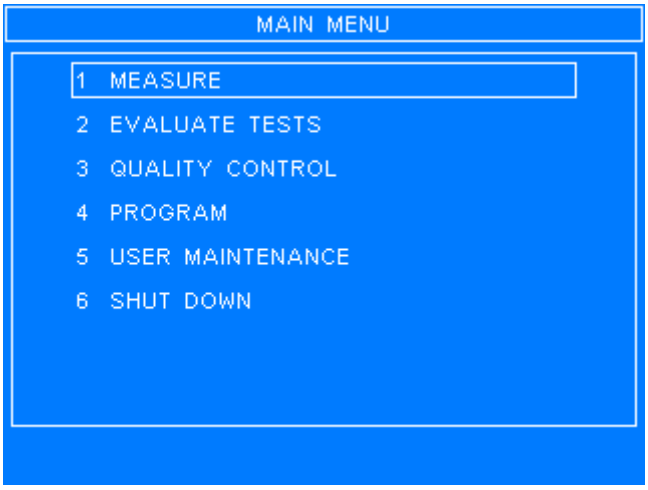
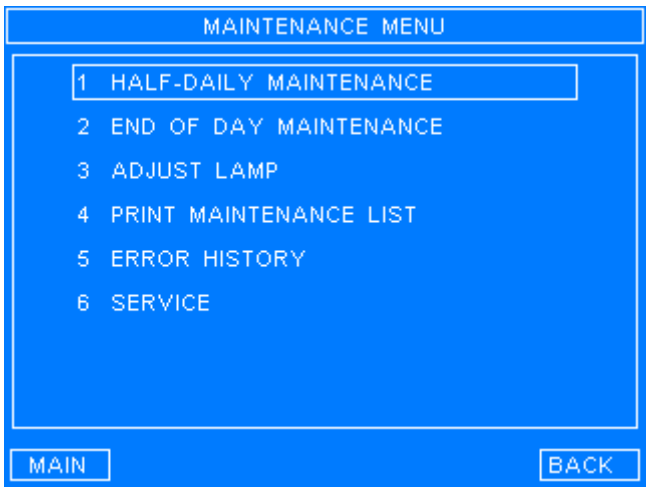
8.5 Service Maintenance

This section deals with the functional checks designed to support the service technician in maintaining the instrument and for troubleshooting purposes.

Follow the procedure below to access the **SERVICE** menu:



1. Choose **USER MAINTENANCE** from the **MAIN** menu using the cursor keys and then press the Enter key. Alternatively, press the number 5 on the keyboard.



2. Choose **SERVICE** from the **MAINTENANCE** menu using the cursor keys and then press the Enter key. Alternatively, press the number 6 on the keyboard.

3. Type in the service level password to access **SERVICE** menu.
4. Press the Enter key to confirm your password. Access to the **SERVICE** menu of the software will be denied if the wrong password is used.

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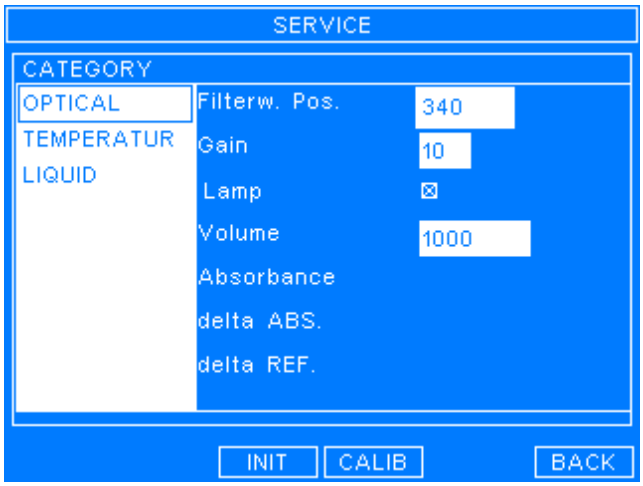
5. Press the BACK softkey to leave the **SERVICE** menu after having carried out the required procedures. The instrument immediately performs a reset to ensure that it can carry out its functions correctly please refer to chapter 8.2, "Power On Check" for more details.



The three categories in this section are:

OPTICAL

TEMPERATUR

LIQUID

The active category is highlighted by a single border. The OPTICAL category is active by default when accessing this section of the software.

8.5.1 OPTICAL category settings

Use this area to check the correct functioning of the filters, lamp and pump. The following positions of the OPTICAL category may be accessed on the right hand side. The settings default settings are displayed when accessing this category.

Filterwheel position	340
Gain	10
Lamp	x (indicates that the lamp is on)
Volume	1000

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8.5.1.1 Checking the filters

Follow the procedure below to check the correct functioning of the filters via the absorbance, delta ABS and delta REF readings.

1. Press the Enter key or use the Left/Right cursor keys to focus the cursor on the edit box for the Filterwheel Position on the right hand side.
2. Use the Up/Down cursor keys to choose a filter whose readings are to be checked then press the Enter key. The instrument will display the Absorbance, delta ABS. and the delta REF. readings for the chosen filter.

   The following positions are read only. The values displayed below are examples

   Absorbance 3630

   delta ABS. -17714

   delta REF. 932

   The example values shown here are calculated as follows: (the measured absorbance at the current wavelength and gain) minus (the measured absorbance at 340 nm gain 0). The last measurement will be executed just once at the beginning of the absorbance measurement.

   a. Absorbance: this value is the direct measured absorbance value in 0.1 mAbs.

   b. delta ABS.: this value is the current measured absorbance corrected with the absorbance at gain 0 in 0.1 mAbs.

   c. delta REF.: this value is the difference between the measured reference signal and the theoretical reference signal in 0.1 mAbs.

Note

When the absorbance value is too low to measure, i.e., the gain is too high, in this case, instead of the absorbance value, the value -99999 is shown.

3. Set the required Gain value from 1 to 10 using the number keys, in accordance with reagent or test procedure specifications.
4. Use the Space bar to turn the lamp off or on at the check box.
5. Press the CALIB softkey to ensure that the instrument can determine the exact centre of each filter installed. The following message is displayed, replacing the word **SERVICE**: "Calibrating... may take 2 mins".

   The instrument now measures the zero value of the water in combination with the filter and flowcell with the gain value set for this wavelength.

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6. Press the INIT softkey to move the filterwheel to its zero position or if any parts are replaced on the analyser.

7. If it is necessary to replace defective filters, please refer to chapter 7.4.6, "Mounting IFL" filters.

8.5.1.2 Check correct functioning of pump

It is possible to weigh a predetermined amount of water to check the correct functioning of the pump. Before carrying out this check, the instrument must first carry out a flush routine to ensure that all system tubes are completely filled with water (Please refer to the User's Manual, chapter 10.2, "End of Day Maintenance"). Follow the procedure below to check the correct functioning of the pump:

1. Focus the cursor on the Volume edit box using the Left/Right cursor keys.

2. Enter the amount of water to be weighed.

   The amount to be entered has a factor of ten (10). Thus if the amount of water to be dispensed is 1200 µl, then the figure entered must be 12000. The maximum figure that can be entered is 15000, which results in 1500 µl being aspirated.

3. Press the Enter key to aspirate the pre-set volume. It is now possible to check the volume by means of:

   1: the volume dispensed through the waste tube.

   2: the aspirated volume from the bottle (weigh the water left in the bottle).

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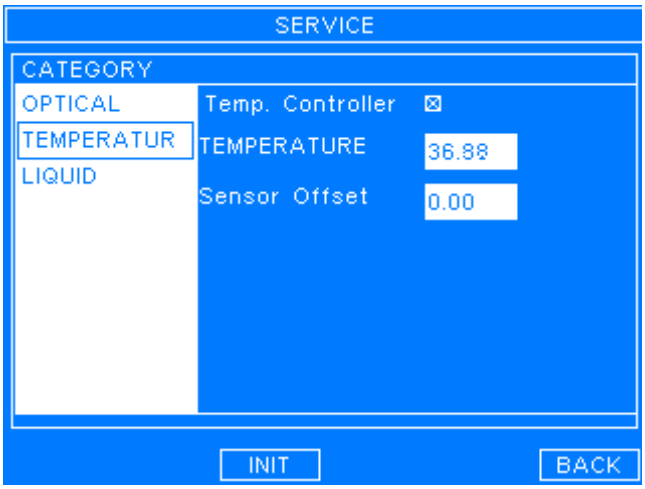
8.5.2 TEMPERATURE category settings



8.5.2.1 Deactivating the temperature controller

Use this area to enter a new Sensor Offset value, check if the temperature controller is functioning correctly or to carry out a test below 37 °C.

Follow the below to enter the TEMPERATUR category.

1. Choose the TEMPERATUR category from the **SERVICE** menu using the Up/Down cursor keys.

   The following positions of the TEPERATURE category may be accessed on the right hand side. The Temperature Controller default is on.

   Temperature Controller x

   Sensor Offset 0.00

2. Use the Right cursor key to access the Temp. Controller check box.
3. Use the Space Bar to activate or deactivate the Temperature Controller for the flowcell. If deactivated the peltier element is bypassed and the temperature will rise or fall according to the ambient conditions.
4. The TEMPERATURE value is read only. It indicates the temperature at the flowcell, which should read 37 °C +/- 0.2 °C.

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8.5.2.2 Setting the sensor offset

The Sensor Offset value is set during the manufacturing stage. If the Opto board needs to be replaced the new Sensor Offset value, which is printed on the Opto board, must be entered here. Follow the procedure below to set the new Sensor Offset value:

1. Focus the cursor on the Sensor Offset edit box.
2. Delete the existing Sensor Offset value using the Backspace key.
3. Enter the required value using the number keys.
4. Press the INIT softkey to initialise the instrument.

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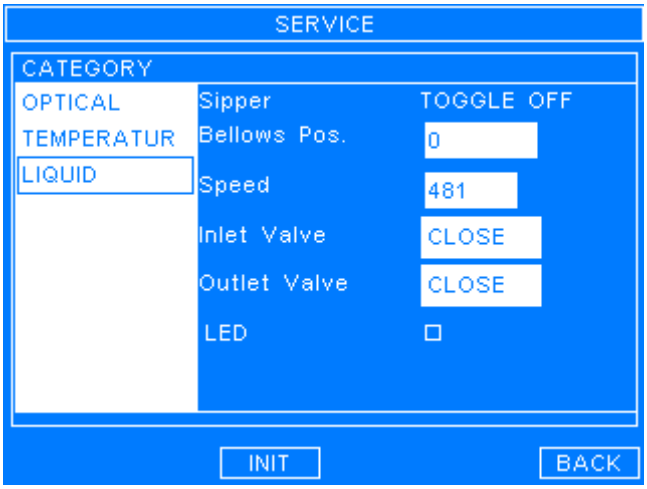
8.5.3 LIQUID category settings



Use this area to check the correct functioning of the bellows, the inlet and outlet valves and the LED on the service cover. It is also possible to set the speed of the stepper motor. Remove the service cover to view the devices reacting to the settings made.

Follow the procedure below to enter the LIQUID category.

1. Choose the LIQUID category from the **SERVICE** menu using the Up/Down cursor keys.

   The settings for the LIQUID category may be accessed on the right hand side. The SIPPER is set to TOGGLE OFF by default and cannot be accessed.

   The settings given below are default values.

Bellows Position	0
Speed	481
Inlet Valve	CLOSE
Outlet Valve	CLOSE
LED	☐

   Use the Left/Right cursor keys to navigate between the positions on the right hand side.

2. Delete the value in the Bellows Position edit box.

   The amount to be entered has a factor of ten (10). Thus if the bellows are to aspirate 1200 µl, the figure entered must be 12000. The maximum figure that can be entered is 15000, which results in 1500 µl being aspirated.

3. Type in the required speed of the stepper motor. The figure recommended is 481.

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Note

The speed of the bellows pump can only be changed in the service menu. When you leave the service menu, the speed returns to the default value.

4. Toggle the Inlet valve as required to OPEN or CLOSE using the Up/Down cursor keys.
5. Toggle the Outlet valve as required to OPEN or CLOSE using the Up/Down cursor keys.

   If necessary, please refer to chapter 7.4.11, "Replacing the bellows".
6. Turn the LED on at the service cover off and on using the Space Bar.
7. Press the INIT softkey to initialise the instrument if any parts have been replaced on the analyser.

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9. Troubleshooting

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9 Troubleshooting

9.1 Overview

The Micro Series is an error-tolerant system with proven accuracy and precision of results and general handling. However, it is not possible to exclude all possible problems. This chapter offers you assistance in localising and solving possible problems as well as referring you to the appropriate chapters in both the Service and User's Manuals. It does not provide an overall step-by-step troubleshooting guide, but is intended to supply general guidelines on how to proceed in case of failure.

User maintenance is of the utmost importance. It is extremely important that the cleaning instructions for the fluid system as described in the User's Manual are followed closely. As a general rule, flow systems are sensitive to the quality of the sample. Pollution of the sample can cause obstructions of the fluid system, for example, air bubbles, clotting, protein fibres etc.

Chapter 10, "Maintenance" of the User's Manual describes user maintenance procedures. The Error History function described in chapter 10.8 of the User's Manual will assist in localising and thus in solving problems.

Chapter 11, "Troubleshooting" of the User's Manual contains some symptoms, probable causes and remedies as well as corrective procedures that the user should carry out before requesting the assistance of the service technician.

As an experienced service technician, you will appreciate that a considerable degree of problems with instruments are in general the result of external causes. Environmental problems such as heavy line voltage fluctuations (peaks, spikes and so forth), inadequate earth ground connections, dust (especially in combination with high ambient humidity), corrosive vapours (acid), dirt, amongst others, can all affect the performance of an instrument. Also the test parameters should be checked against the manufacturer's package inserts when errors appear instead of results.

High intensity light (direct sunlight or from artificial sources) might also affect the operation of sensitive photometric equipment. Additionally, the instruments will be adversely affected by extreme high or low ambient temperatures (see chapter 4, "Installation Procedures").

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9.1.1 Electronic failures

If an electronic failure is suspected you should always check the supply voltage first, as this is probably the most critical section of the electronics.

9.1.2 Processor board

The main processor board has been manufactured using SMD technology. This implies that on-the-spot repairs or even in the workshop will not be possible. Therefore, we strongly advise that you contact the service department of Vital Scientific. N.V. in case of failure.

9.1.3 Mechanical failures

Check the sipper tube and fluid system for leaks or obstructions as well for loose connections when obvious mechanical problems occur, for example, sample/water under the instrument. If the fluid system is blocked, it should be flushed with distilled water and 5% detergent (Mucasol) at 37 °C for at least 10 minutes. Inspect tubing at least once a year and replace if required.

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9.2 Error Messages

The error messages that the instrument displays in the case of a malfunction are given in the table below. The table is made up of five columns: the **Error number** column and the **Error text** column relate to the error message. The **Cause** column lists possible reasons for the error being issued. The **User** column contains the suggested user reaction. Finally, the **Service** column lists suggested action to be taken by the service technician or, where appropriate, refers him/her to the chapter and manual where a more detailed procedure is described.

A basic assumption for the error messages listed in the table below is that the power supply is functioning correctly. Please refer to chapter 6.3.2, "Power supply, detailed specifications", and in the Appendix, A.4, "Electrical Drawings", Logic power supply (17 of 21) and 24V / -20V Inverter & 12V supply (18 of 21).

The errors listed below are not always displayed on the monitor during operation of the instrument, but are always recorded in the error history. For example, the error 011 "ROM Failure" is not always displayed on the monitor, because the instrument solves the problem autonomously. However, all errors and warnings are logged in the error history (please refer to chapter 10.8, "Error History" in the User's Manual for a more detailed explanation of this function).

The service technician should also refer to chapter 6, "Technical Information". The relevant drawings and wiring diagrams are contained in the Appendix.

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Error No.	Error text	Cause	User	Service
000	Temperature time out	Flow cell did not reach 37 °C +/- 0.2 °C (offset is taken into account) within 1 hour after start up. Peltier element/sensor defect. Note: a test is made before every measurement to check that the temperature is stable at 37 °C +/- 2°C. If the temperature is out of range, a T-flag is added to the results. Note: when a temperature error occurs the peltier element is switched off to prevent damage to the flow cell.	**Switch** off the instrument, wait one minute then switch the instrument on. **Check** that the environment conditions are within the specified limits. **Check** that the filter at the rear of the instrument is not clogged. **Ensure** that the environment conditions are met. Call service technician.	**Check** temp sensor. If the sensor is malfunctioning replace the photometer board; remember to set the offset in the temperature menu. **Check** resistance of the peltier element. Replace if necessary. **Check** connections between the processor board and the peltier element/sensor (please refer to the Appendix, A.4 "Electrical Drawings"). **Check** connections to the integrated photometer board are secure. **Check** for obstructions in the airflow to the heat sink of the peltier element. **Check** temperature paste between heat sink peltier and house assy. **Check** that the offset setting in the temperature menu is the same as in the instructions on the photometer board. **Refer** to chapter 8.5.2, "TEMPERATURE category settings" to carry out a functional check of the temperature controller and sensor offset settings. **Note**: the overheat protection can be switched off in the service menu; overheating can cause damage to the optical system.
001	Blank out of range	No or insufficient light.	**Check** lamp and lamp adjustment. **Refer** to the User's Manual, chapter 11.1.1, "Problems with samples and reagents".	**Check** voltage supplies, and connections to the lamp. **Check** if lamp is of recommended type and fitted correctly. **Refer** to chapter 8.5.1, "OPTICAL category settings" for functional test (particularly of the gain setting). **Refer** to chapter 10.6, "Replace and adjust lamp" of the User's Manual, if necessary. **Ensure** that the filter is not dirty or defective.

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Error No.	Error text	Cause	User	Service
002	Ref. out of range	Reference out of range. The counter of the internal reference capacitor (signal conversion) is not within the expected limits. Parameters wrong.	**Switch** off the instrument, wait one minute then switch the instrument on. **Check** parameter settings. Call service technician.	**Check** that the offset setting in the temperature menu is the same as in the instructions on the photometer board. **Refer** to chapter 8.5.2, "TEMPERATURE category settings" to carry out a functional check of the temperature controller and sensor offset settings. **Replace** the photometer board, if necessary.
003	Pump steps lost	Voltage fluctuation, obstruction in the fluid system, stepper motor malfunction. The vane of the bellows pump is not in the opto switch at the expected moment.	**Switch** off the instrument, wait one minute then switch the instrument on. **Check** that the waste container is located on the same (or lower) level as the instrument. Call service technician.	**Check** voltage supplies and electrical connections to pump unit. **Check** all tubing, including the waste tube for clogging. **Ensure** the pump is moving via the service menu. **Check** the valves are functioning correctly. **Refer** to chapter 8.5.3, "LIQUID category settings" to make functional check of the bellows pump and carry out volume test of pump. **Refer** to chapter 8.5.1. "OPTICAL category settings" to recalibrate the pump following functional check. **Check** the resistance of the coils of the motor. **Dismount** the pump unit and check the transmission of the pump (clean and lubricate, if necessary).
004	FW: steps lost	Voltage fluctuation. Filterwheel steps lost. The opto switch of the filterwheel is not activated at the expected time.	Call service technician.	**Check** voltage supplies to the filterwheel and for mechanical obstructions. **Check** the opto switch. **Check** the resistance of the coils of the motor. **Check** the mounting of the filterwheel to the shaft of the motor. **Check** if the filterwheel can move freely. **Refer** to chapter 8.5.1, "OPTICAL category settings" to calibrate the filterwheel.

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Error No.	Error text	Cause	User	Service
005	FW: Cal. too dark	Lamp defective, not set correctly, filter dirty or defective. Filter wheel calibration to dark. During the calibration of the filterwheel, less light is transmitted than expected (only the filter in the first position of the filterwheel is checked).	**Replace** lamp. Call service technician.	**Check** the voltage supplies. **Check** 12 V voltage supply to the lamp. **Check** if lamp is of recommended type. **Check** lamp adjustment. **Check** if filter is dirty or defective. **Check** the photometer board. **Check** the mounting of the filterwheel to the shaft of the motor. **Refer** to chapter 8.5.1, "OPTICAL category settings".
006	Temp hardware error	An interrupt has been generated at an unexpected moment.	**Switch** off the instrument, wait one minute then switch the instrument on. Call a service technician if the message occurs persistently.	**Check** the voltage supplies. **Perform** a general troubleshooting procedure.

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Error No.	Error text	Cause	User	Service
007	Temp. To high	The temperature of the flow cell is > 45 °C. Notice that when a temperature error occurs the peltier element will be switched off to prevent damage to the flow cell.	**Switch** off the instrument, wait one minute then switch the instrument on. **Check** that the environment conditions are within the specified limits. **Check** that the filter at the rear of the instrument is not clogged. Call service technician.	**Check** temp sensor. **Check** the resistance of the peltier element. **Check** connections between the processor board and the peltier element/sensor (please refer to the Appendix, A.4, "Electrical Drawings"). **Check** connections to the integrated photometer board are secure. **Replace** the processor board, if necessary. **Replace** photometer board, if necessary. **Check** for obstructions in the airflow to the heat sink of the peltier element. **Check** temperature paste between heat sink peltier element and house assy. **Check** that the offset setting in the temperature menu is the same as in the instructions on the photometer board. **Refer** to chapter 8.5.2, "TEMPERATURE category settings" to carry out a functional check of the temperature controller and sensor offset settings. **Note**: the overheat protection can be switched off in the service menu; overheating can cause damage to the optical system.

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Error No.	Error text	Cause	User	Service
008	Temp. To low	The temperature of the flow cell is < 15 °C.	**Switch** off the instrument, wait one minute then switch the instrument on. **Check** that the environment conditions are within the specified limits. **Check** that the filter at the rear of the instrument is not clogged. Call service technician.	**Check** temp sensor. If the sensor is malfunctioning replace the photometer board; remember to set the offset in the temperature menu. **Check** resistance of the peltier element. Replace if necessary. **Check** connections between the processor board and the peltier element/sensor (please refer to the Appendix, A.4 "Electrical Drawings"). **Check** connections to the integrated photometer board are secure. **Check** for obstructions in the airflow to the heat sink of the peltier element. **Check** temperature paste between heat sink peltier and house assy. **Check** that the offset setting in the temperature menu is the same as in the instructions on the photometer board. **Refer** to chapter 8.5.2 "TEMPERATURE category settings" to carry out a functional check of the temperature controller and sensor offset settings. **Note**: the overheat protection can be switched off in the service menu; overheating can cause damage to the optical system.

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Error No.	Error text	Cause	User	Service
009	Pump init fails	Voltage fluctuation, obstruction in the fluid system. The vane of the bellows pump is not in the opto switch at the required moment.	**Switch** off the instrument, wait one minute then switch the instrument on. **Check** that the waste container is located on the same (or lower) level as the instrument. Call service technician.	**Check** voltage supplies. **Check** all tubing and flowcell for clogging or air bubbles. **Check** that tubing to the valves is fitted correctly. **Remove** tubes and roll between the fingers. **Replace** damaged tubing. **Check** the valves are functioning correctly **Check** if sipper tube is fitted correctly. **Check** seals. **Flush** the system. **Ensure** the pump is moving via the service menu. **Check** the functioning of the reset opto of the pump unit. **Refer** to chapter 8.5.3, "LIQUID category settings" to make functional check of the bellows pump and carry out volume test of pump. **Refer** to chapter 8.5.1, "OPTICAL category settings" to recalibrate the pump following functional check. **Check** that the waste container is located on the same (or lower) level as the instrument. **Check** the resistance of the coils of the motor. **Dismount** the pump unit and check the transmission of the pump (clean and lubricate, if necessary).
010	FW init fails	Voltage surge. Filterwheel initialisation has failed. The filterwheel could not be initialised.	Call service technician.	**Check** voltage supplies. **Check** the opto switch. **Check** the resistance of the coils of the motor. **Check** connections from the processor board to the filterwheel motor. **Check** the mounting of the filterwheel to the shaft of the motor. **Check** if the filterwheel can move freely. **Refer** to chapter 8.5.1, "OPTICAL category settings" to calibrate the filterwheel.

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Error No.	Error text	Cause	User	Service
011	Rom Failure	Voltage fluctuation, processor board or battery failure. The checksum of the Rom module is not in accordance with the expected value.	Instrument restarts automatically.	**Check** voltage supplies. **Refer** to chapter 6.3.3, "Microcontroller and logic core". **Replace** processor board.
012	NV Ram Failure	Voltage fluctuation, processor board or battery failure. Checksum of the non volatile Ram is not in accordance with the expected value.	Instrument restarts automatically.	**Check** voltage supplies. **Check** battery. **Refer** to chapter 6.3.3, "Microcontroller and logic core". **Replace** processor board.
013	FW Cal: curve stays low	Voltage fluctuation, FW stepper motor has lost steps. Filterwheel calibration curve remains low. During calibration of the filterwheel the transmission of the filter in the first position remains high	**Switch** off the instrument, wait one minute then switch the instrument on. Call service technician.	**Check** if filter is absent. **Check** voltage supplies. **Check** that the filterwheel stepper motor is correctly aligned. **Check** the mounting of the filterwheel to the shaft of the motor. **Refer** to chapter 8.5.1, "OPTICAL category settings" for functional check of filters and to calibrate the filterwheel. **Check** the resistance of the coils of the motor. **Check** connections from the processor board to the motor.

Error No.	Error text	Cause	User	Service
014	FW Cal: curve to small	Voltage fluctuation, FW stepper motor has lost steps. Filter is dirty. Filterwheel calibration curve is too small. During calibration of the filterwheel the measured transmission curve of the first filter is smaller than expected.	**Switch** off the instrument, wait one minute then switch the instrument on. Call service technician.	**Check** if filter is dirty/defective or aged. **Check** the mounting of the filterwheel to the shaft of the motor. **Refer** to chapter 8.5.1, "OPTICAL category settings" for functional check of filters and to calibrate the filterwheel. **Check** the resistance of the coils of the motor. **Check** if the filterwheel can move freely. **Check** connections from the processor board to the motor.
015	FW Cal: midpoint range	Filterwheel calibration: midpoint range. The centre of the first filter can not be found during calibration. The transmission curve of the filter in the first position of the filterwheel is smaller than expected.	**Switch** off the instrument, wait one minute then switch the instrument on. Contact service technician.	**Check** the voltage supplies. **Check** if the filter is dirty or aged. **Check** that the filterwheel stepper motor is correctly aligned. **Check** if the filterwheel can move freely. **Check** the mounting of the filterwheel to the shaft of the motor. **Refer** to chapter 8.5.1, "OPTICAL category settings" for functional check of filters and to calibrate the filterwheel. **Check** the resistance of the filterwheel motor coils. **Check** connections from the processor board to the motor.

9.3 Warnings

The following warnings may be displayed by the instrument:

Warning	Cause	User	Service
Ext. Printer not on line	The online signal or the Hi signal from the printer is not active. No paper.	**Check** cable connections. **Switch** the printer on. **Set** the printer on line. **Load** paper.	**See** user column. **Check** all electrical connections. **Ensure** that the EXTERNAL PRINTER checkbox is selected in the HARDWARE category of the SYSTEM SETTINGS. **Refer** to chapter 5.4.2 of the User's Manual.
Ext printer printing error	Error signal from the printer active.	**Reset** the printer.	**See** user column. **Check** all electrical connections.
Int. Printer not on line	Malfunction internal printer.	**Check** cables / connections. Call service technician.	**See** user column. **Replace** printer.
Int printer printing error	Malfunction internal printer.	**Check** cables / connections. Call service technician.	**See** user column. **Replace** printer.
Host connection lost	No communication with the host computer.	**Check** the cables. **Switch** the host computer on. Call service technician.	**Check** the cable connections. **Check** the communication software on the host. The acknowledge signal from the host was not received (software handshaking, heartbeat mechanism). **Refer** to Appendix, A.1, "Target Host communications".
External keyboard error	Wrong keyboard connected, internal error of the keyboard.	**Replace** the keyboard with a prescribed keyboard. **Replace** the keyboard.	**See** user column. **Refer** to the Appendix of the User's Manual, A.1.1, "Install the external keyboard".

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Warning	Cause	User	Service
Primary wavelength not in filterwheel	Generated before a test is performed. The wavelength as programmed in the test parameters is not mounted in the filterwheel.	**Adjust** test protocol.	**Check** that the filterwheel stepper motor is correctly aligned. **Refer** to chapter 8.5.1, "OPTICAL category settings" for functional check of filters and to calibrate the filterwheel. **Install** the correct filter. **Refer** to chapter 8.4.1, "Adding filter wavelengths". **Refer** to chapter 7.4.6, "Mounting IFL filters".
Secondary wavelength not in filterwheel	Generated before a test is performed. The wavelength as programmed in the test parameters is not mounted in the filterwheel.	**Adjust** test protocol. Contact service technician.	**Install** the correct filter. **Refer** to chapter 8.4.1, "Adding filter wavelengths". **Refer** to chapter 7.4.6, "Mounting IFL filters".
About to delete	Delete action.	**Double** check.	**Double** check.
Calibrating … may take 2 mins	The filterwheel is being calibrated.	**Wait** until calibration is performed.	**Wait** until calibration has been performed.
Password not between 3 and 6 chars	Password contained wrong amount of characters.	**Enter** a correct password containing 3 to 6 characters.	**Enter** a correct password containing 3 to 6 characters.
Water blank failed	Less transmission than expected.	**Perform** cleaning of the instrument. **Re-measure** the water blank.	**Check** voltage supply of the lamp 12 V. **Check** lamp adjustment. **Check** the transmission of the filters in the service menu. **Check** the mounting of the filterwheel to the shaft of the motor. **Check** the photometer board.
Target values not accepted	The entered value is not logical. For example, the high limit is lower than the low limit.	**Check** limit values.	**See** user column.

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Warning	Cause	User	Service
Measurement under range	The transmission is too high and can not be measured.	**Check** liquids.	**Check** liquids. **Check** if lamp is of recommended type and fitted correctly. **Check** that the filterwheel stepper motor is correctly aligned. **Refer** to chapter 8.5.1, "OPTICAL category settings" for functional check of filters and to calibrate the filterwheel.Hardware error (the signal of the photo sensor is higher thans the signal from the reference capacitor) replace signal conversion board.

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